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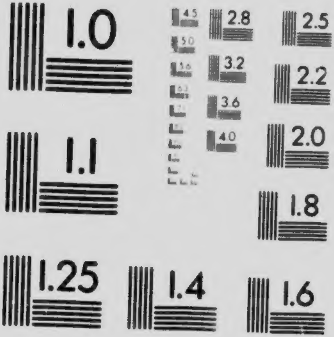

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GEOLOGICAL SURVEY OF CANADA
A. P. LOW, DEPUTY HEAD AND DIRECTOR

SECOND EDITION

OF A

REPORT

ON THE

GEOLOGY AND NATURAL RESOURCES

OF THE AREA INCLUDED BY THE

NIPISSING AND TIMISKAMING MAP-SHEETS

COMPRISING PORTIONS OF THE

DISTRICT OF NIPISSING, ONTARIO
AND OF THE
COUNTY OF PONTIAC, QUEBEC

BY

ALFRED ERNEST BARLOW, M.A.

OTTAWA
PRINTED BY S. E. DAWSON, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1907

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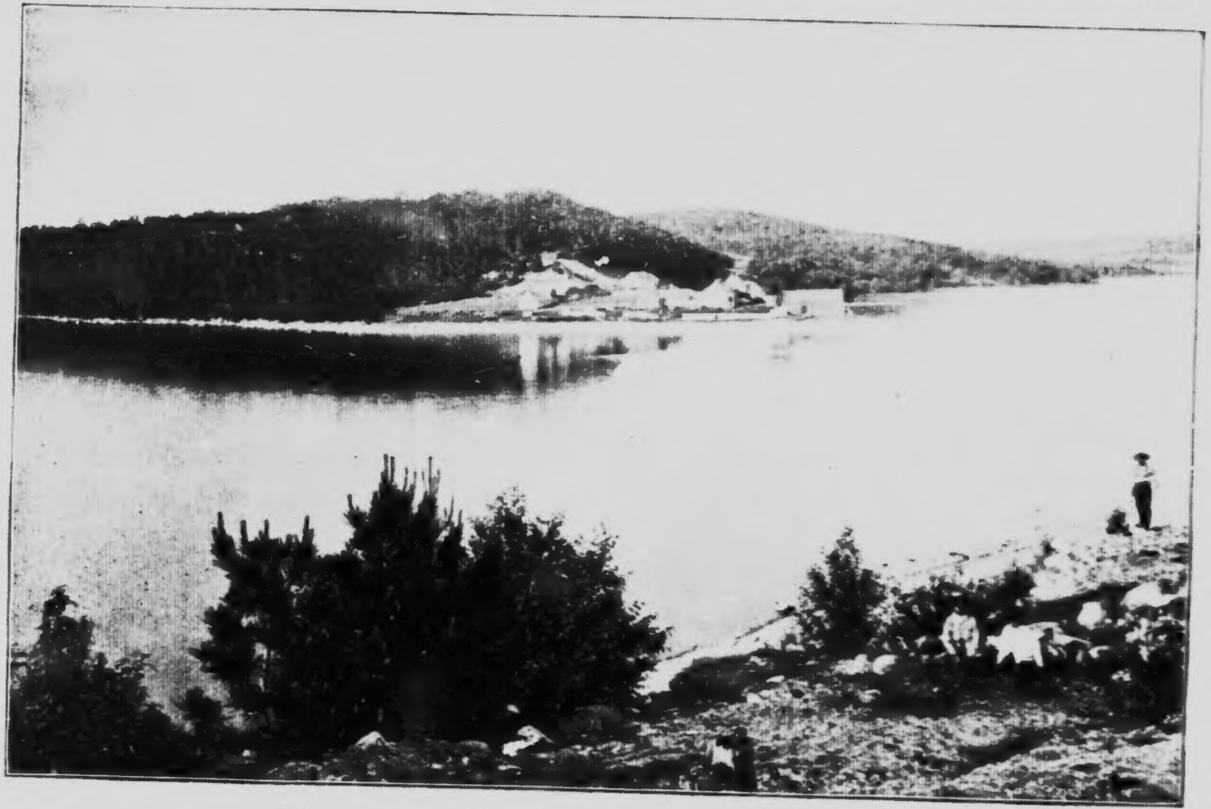

THE NARROWS (OBATCHEWANUNG), LAKE TIMISKAMING.

A constriction produced by an accumulation of sand, gravel and boulders, representing a terminal moraine of the glacier which occupied this valley about the close of the Glacial Period.

4330

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A. P. Low, Esq.,

Director, Geological Survey of Canada.

Sir,—I beg to transmit herewith the second edition of my report on the geology, physical features and natural resources of the region in the vicinity of Lakes Nipissing and Timiskaming, comprising portions of the district of Nipissing, Ontario, and the county of Pontiac, Quebec. The report is accompanied by two maps, each on a scale of four miles to one inch, constituting sheets Nos. 130 and 138, respectively, of the Ontario series of geological maps.

My grateful acknowledgments for much kind assistance are due to Mr. W. F. Ferrier, once of this Survey, as lithologist, to whom was entrusted the determination and description of many of the microscopic sections, especially of some of the more critical ones; to Dr. F. D. Adams, of McGill University, Montreal, for aid and advice on some points connected with the petrography of the district; to Dr. H. M. Ami and Mr. L. M. Lambe, of this Survey, for their examination of the collections made from the several Palæozoic outliers and the preparation of detailed lists of the fossils.

Acknowledgments are also due to Mr. Colin Rankin and Mr. H. K. Beeston, of the Hudson's Bay Company, who did everything in their power to forward the objects of the exploration; to Messrs. Frank Norris, of Baie des Pères, John Turner, of Timagami lake, and Stephen Lafricain, of Bay lake, officers-in-charge at these several places or posts belonging to the same company; to Mr. M. H. McLeod, C.E., engineer-in-charge of the construction of the Timiskaming branch of the Canadian Pacific railway, and also to Messrs. J. C. Bailey, C.E., of Toronto, and H. K. Wickstead, C.E., of Cobourg, engineers-in-charge of the location of the projected Nipissing and James Bay railway, for information in regard to elevations at various points situated along or in the vicinity of the lines represented; to Mr. John Mann, of Baie des Pères; to Messrs. C. C. Farr and P. A. Cobbold, of Haileybury; to Messrs. J. B. and R. A. Klock, of Klock's Mills; to the Imperial Lumber Co., of Warren, Ont.; to Capt. Percy, late of the steamer *Meteor,* and Capt. J. O. Blondin, of the steamer *Clyde*, on Lake Timiskaming, and many others.

I have the honour to be, Sir,
Your obedient servant,
ALFRED ERNEST BARLOW.

Ottawa, January, 1907.

NOTE.—*The bearings throughout this report are given with reference to the true meridian.*

00025438

REPORT

(SECOND EDITION)

ON THE

GEOLOGY AND NATURAL RESOURCES

OF THE AREA INCLUDED BY THE

NIPISSING AND TIMISKAMING MAP-SHEETS

COMPRISING PORTIONS OF THE

District of Nipissing, Ontario, and of the County of Pontiac, Quebec

INTRODUCTORY.

The following report treats of that portion of the district of Nipissing, Ontario, and the county of Pontiac, Quebec, lying between latitudes 46° 13′ 21″ and 47° 36′ 47″ north, and extending from longitude 78° 49′ 54″ to longitude 80° 22′ 26″ west of Greenwich. This area is comprised in the two maps accompanying the report, known as the Nipissing and Timiskaming sheets, or Nos. 131 and 138 respectively, of the Ontario series of geological maps, on a scale of four miles to one inch. The district which each map represents measures seventy-two miles in length from east to west, and forty-eight miles from north to south, thus embracing an area of 3,456 square miles, or a combined area of 6,912 square miles. The Nipissing sheet includes nearly the whole of Lake Nipissing and considerable portions of Lakes Timagami, Timiskaming and Kipawa, the boundary between the two sheets cutting the three last-named lakes about latitude 46° 55′. The main line of the Canadian Pacific railway traverses the southern part of the Nipissing sheet, the eastern limit crossing the railway between Calvin and Eau Claire stations, while the western boundary is situated a short distance west of Warren station. The town of North Bay is the most populous and important place, and is one of the divisional points on the Canadian Pacific railway, as well as the present terminus of the Northern division of the Grand Trunk railway, although the actual intersection of the two lines is at Nipissing Junction, three miles southeast of North Bay. The Timiskaming and Northern Ontario railway, operated by a Commission appointed by the Government of Ontario, traverses this district from south to north. A portion of the border of the map, near the southeast corner, has been broken in order to show the position of the comparatively old and important town of Mattawa, at the confluence of the Ottawa and the Mattawa rivers, as well as the junction of the Timiskaming and Kipawa branches of the Canadian Pacific railway.

The Timiskaming sheet contains the northern parts of lakes Timagami, Timiskaming and Kipawa, and the southern portion of Lac des Quinze. The Ottawa river, from Mattawa to Lac des Quinze, flows through the region covered by the two maps, the deep-water channel of this stream forming the boundary between the provinces of Ontario and Quebec. There is thus an area of about 1,780 square miles situated within the province of Quebec, forming part of the county of Pontiac, while the remainder, 5,132 square miles, is included in the district of Nipissing, Ontario. Of the area situated in the province of Quebec only about 260 square miles have been surveyed into lots, included in the townships of Neudlac, Guigues, Baby, Duhamel, Laverlochère, Fabre and Gendreau, bordering on Lake Timiskaming; while in the province of Ontario an area of about 1,911 square miles has been laid off into townships and lots, the greater portion of which (1,685 square miles) is contained within the limits of the Nipissing sheet. The greater number of the townships on the Ontario side are of the more recent form adopted by the Crown Lands Department of that province, and measure six miles square, each township thus embracing an area of thirty-six square miles. Every township is divided into six concessions by east-and-west lines, run astronomically, which are designated by the Roman numerals, the order of numbering being from south to north, while the concessions themselves are subdivided into twelve lots by true north-and-south lines, which carry the ordinary Arabic figures. Each lot, therefore, measures one mile from north to south and half a mile from east to west, thus containing a superficies of 320 acres. Only every alternate lot-line is cut out through the bush, the intervening boundary being simply marked by a post on the concession line, these being known as 'blind lines.' A road allowance occurs every mile, coinciding with the township, concession, and side lines; while occasionally the 'blind lines' are utilized for this purpose. The lines are all supposed to be run astronomically east-and-west or north-and-south as the case may be, although in some instances no allowance has been made for the convergence of meridians, thus giving rise to considerable error and confusion. Bordering the Mattawa river and Lake Nipissing, as well as on the western shore of Lake Timiskaming, the townships are of a somewhat larger size, corresponding in this respect with those of southern Ontario, while to the south of the Mattawa river the townships belong to the older set, both in regard to size and the direction of their outlines and lines of subdivision.

On the Quebec side the townships seem to have no regular or stated size, and while the lines are astronomical their direction is determined by the general trend of the water-front. As a consequence, the lines of subdivision in the townships of Guigues, Duhamel, &c., are all run north-and-south or east-and-west respectively, as the upper portion of Lake Timiskaming has, in general, a north-and-south direction, while the township boundaries and side-lines of Gendreau and other townships situated in the southern part of Lake Timiskaming have a direction of N. 60° E. or at right angles to the general trend of the lake in this vicinity, which is thirty degrees east of south. The distance between concession-lines is slightly over a mile, but the lots themselves are much narrower than those on the Ontario side, each being designed to contain about 100 acres, although in many instances this area is much diminished or increased. The concessions are denoted by the Roman numerals, while the ordinary figures are applied to the lots. Occasionally, both in Ontario and Quebec, the letters of the alphabet have been used to designate the concessions.

The preliminary part of the work in this district was done in 1887-88, while acting under instructions from Dr. R. Bell, as his assistant; but only about two months of each season were devoted to this work, and by far the greater portion of this time was occupied in some of the many detailed surveys necessary in a region concerning which but little had hitherto been known. This topographical survey was, of course, accompanied by as many observations regarding the nature and distribution of the various rock formations encountered as was possible in a survey of the kind.

The more pressing nature of the work in connexion with the Sudbury mining district caused my removal from this field to assist Dr. Bell in tracing out the geological and topographical details necessary for the map and report concerning that region, so that work was not resumed on the Nipissing and Timiskaming sheets until 1892. The bulk of the work on these two maps was accomplished between 1892 and 1894, although about two months of the season of 1895 was required to complete it. It was found necessary to make a large number of topographical surveys, especially in the northern part of the district, and this portion of the work occupied by far the greater portion of our time and attention; but the detailed results thus obtained have added largely to our geographical knowledge of a region of which the physical features were but rudely represented, if at all, on the maps hitherto published.

The distances were measured with a Rochon micrometer telescope, while the direction was determined by prismatic compass. The distances thus obtained from point to point were further utilized as bases for a compass triangulation, by which the position of many of the smaller islands and some of the more conspicuous points on the mainland, otherwise inaccessible, were defined with sufficient accuracy. About the middle of July, 1887, agreeably with instructions received from Dr. Bell, then in charge of the work in the district of Nipissing, I proceeded from Lake Timiskaming by way of the Matabitchouan river and Rabbit lake to Timagami lake, in order to complete a detailed topographical and geological survey of that lake. This survey was commenced on July 23rd. The work was considerably retarded owing to the frequent presence of smoke caused by the unusually large number of bush fires, and on many days this smoke was so dense as to render all attempts at surveying quite useless. Another cause which militated very greatly against the rapid and successful prosecution of the work during this and succeeding seasons was the difficulty in procuring and retaining the services of suitable canoemen. In spite of these drawbacks, however, the survey of Timagami lake was finished by September 15th, when a similar survey was undertaken of the route by way of White-bear and Rabbit lakes and the Matabitchouan river to Lake Timiskaming. During the summer of 1888 these surveys were continued, but scarcely two months of the season were devoted to field operations in this region. During this time, however, considerable progress was made in the topographical measurements of many of the principal lakes, among the more important of which may be mentioned Cross lake, the northern part of Obabika lake, route from the north arm of Lake Timagami by way of Red-squirrel and Annima-Nipissing lakes to Bay lake on the Montreal river, as well as of many minor sheets of water to the north and northeast of Timagami lake.

In 1892 the survey and examination of the Nipissing district was resumed, with instructions from the Director to make whatever surveys were deemed necessary for maps and a report of an approximately final character. An epitomized statement of the general progress of the work has been given each year, in which mention is also made of the various topographical surveys accomplished each season, in the four Summary Reports of 1892 to 1895.* During 1892 and 1893 I was ably assisted by Mr. J. F. E. Johnston, upon whom devolved the greater part of the topographical work done during these two years. In 1888, and again in 1893 and 1894, I was accompanied by Mr. A. M. Campbell, of Perth. During the season of 1893 I had likewise the advantage of the assistance of Mr. E. M. Burwash, of Victoria University, Toronto.

For cartographical purposes, the various base, meridian and township lines run by the Crown Lands Departments of Ontario and Quebec have been utilized, and serve as excellent checks and corrections to the errors necessarily incident to a micrometer and compass survey. The geographical features of the area covered by the surveyed townships have, in the main, been adopted, supplemented, however, in many cases by additions and corrections of our own, which were sometimes found necessary. This information was chiefly available in the area of the Nipissing sheet, where over half the area has been divided into townships, and these in turn subdivided into concessions and lots. Besides these a number of surveys of a more general character have been made, the manuscripts and published plans of which have been found of much assistance in the general compilation, as well as in furnishing details in many cases not otherwise obtainable. Among the more important of these plans the following may be mentioned: Murray's survey of Lake Nipissing and the Sturgeon river, and Logan's survey of the Mattawa river, published in the folio atlas to accompany the Report of this Survey of 1853-56. Murray's survey of Lake Nipissing, however, did not show sufficient detail in the western portion of the lake, so that a re-survey was carried out early in 1892. Austen's map of the Timagami river, with accompanying traverses made for the purpose of ascertaining the most feasible route for the location of a transcontinental railway line, has also been used. Forrest's survey of the Montreal river was found excellent for all purposes for which it was required. Messrs. O'Dwyer and O'Hanley's survey of the Ottawa river and Lake Timiskaming, to delineate the boundary line between Ontario and Quebec, was found to be thoroughly reliable, while the Canadian Pacific Railway surveys enabled us to locate the exact position of the railway line.

Early Explorations and Previous Surveys.

The history of the exploration of the region in the vicinity of the Upper Ottawa and Mattawa rivers dates back almost to the first settlement of Canada by the French. The almost invariable presence of detached parties of the war-like and much dreaded Iroquois in the region immediately adjacent to the upper St. Lawrence usually forbade the utilization of this main artery as a route towards the west, so that in most instances the more peaceable, though more circuitous, passage by way of the Mattawa and the upper Ottawa rivers was the only practicable channel of communiction between the scattered French settlements on the Lower St. Lawrence and the populous villages of the Hurons and other friendly Indian tribes inhabiting the region in the vicinity of Georgian bay and Lake Simcoe. It is, therefore, not surprising to find that the various physical features presented in the regions in the vicinity of these streams were at a very early date among the best known, being especially familiar to the missionary and fur-trader, whose avocations forced them to make constantly recurring visits to the outposts already established in the distant west and northwest. The most prominent of these geographic features were appropriately designated, and most of the names then bestowed upon the numerous rapids, portages, &c., are still retained in common use throughout the district.

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* Summary Report, Geol. Surv. Can., 1892, Part A, pp. 34-35. 1893, Part A, pp. 30-33. 1894, Part A, pp. 55-57. 1895, Part A, pp. 61-63.

The sheltered nature of its water-stretches, its comparative freedom from molestation, as well as its directness as a route to the great lakes and beyond, formed powerful inducements in favour of the original selection of the Ottawa and Nipissing route, at a time when the birch-bark canoe was the chief, and often the only, method of communication. The advent of steamboat navigation on the St. Lawrence river and the great lakes, however, as well as the building of the St. Lawrence canals, has during the present century caused this route to fall into comparative disuse. The recently revived proposal to make use of these water-courses for purposes of modern navigation by the building of canals to overcome the obstructing rapids seems likely again to bring this district into prominence.

Soon after his arrival in this country, Samuel de Champlain, who was by nature more of an explorer and adventurer than a builder of colonies, determined on an examination of the headwaters of the Ottawa and beyond. He was all the more eager to undertake this investigation as a young man, Nicolas du Vignau, had just returned, in 1612, after a year's absence among the Ottawa Indians, with a most wonderful tale. He claimed, during his absence, to have discovered a passage by way of the Upper Ottawa to the shores of a northern sea to which he had penetrated and there beheld the wreck of an English ship. The apparent clearness and consistency of the story deceived Champlain, who fancied that he might thus find the much coveted road to China and Japan. Towards the end of May, 1613, Champlain, accompanied by this Du Vignau, ascended the Ottawa as far as Lake Coulonge, where he was reluctantly dissuaded by the resident natives from proceeding farther. They urged, as their main excuse for not seeming willing to guide him, the many insuperable difficulties to be encountered on the route, as well as the reputed fierceness and witchcraft of the Nipissing Indians, through whose country it was necessary to pass. Here also he learned that the whole story of Du Vignau's pretended discoveries was a fabrication, and that far from undertaking any such important journey as reported he had resided continuously and quietly at the village during the entire period of his absence from civilization. This information, which was subsequently corroborated by Du Vignau's own tardy confession, enraged and disheartened Champlain, who, convinced of the fruitlessness of any further effort at the time in this direction, returned to Montreal, and subsequently to France.

Early in 1615, however, Champlain returned to Canada, bringing with him four Recollets, one of whom, Father Joseph Le Caron, was destined for missionary work among the Huron Indians. Arriving at Montreal he found a large concourse of Indians already assembled, who had come hither from their homes in the vicinity of Lake Simcoe. These savages, always more eager for temporal than spiritual help, again pressed Champlain to aid them against their hereditary foe, the formidable Iroquois. Deeming it expedient at the time to comply with this oft-repeated request, Champlain hurriedly descended to Quebec to make the necessary preparations, leaving Le Caron and some of his compatriots with the assembled Indians to await his return. During Champlain's absence, however, the Indians decided to go back forthwith to their own home without him, and accompanied by Le Caron and his associates commenced the ascent of the Ottawa river. When Champlain returned to Montreal and found the place deserted he immediately hurried after them, pursuing the usual course up the Ottawa and Mattawa rivers, over the height-of-land to Lake Nipissing and thence down the French river to Lake Huron. Champlain was thus the first European, with the exception of the humble friar who had only just preceded him by a few days, to gaze on the waters of Lake Huron, which he christened 'Mer Douce.'

Champlain's map of New France, which was made in 1632, included all sketches and surveys from 1603 to 1629. Only the main routes of travel are represented, while the whole map exhibits, in a very rough manner, the salient physical features encountered during the progress of these journeys and explorations. Lake Nipissing is called 'Lac de Biserinis,' while a rude outline of the Ottawa river above its confluence with the Mattawa is given that must have been drawn from information supplied by the Indians.

The exploration of this district, as of others elsewhere throughout Canada, is inseparably bound up with the history of the fur trade, the successful prosecution and extension of which required the constant addition of new territory. We thus find that many of the first exploratory expeditions were often undertaken by adventurers at their own expense, with the promise of various marks of distinction from those in authority in case of the success of their undertakings, while fur-trading licenses were granted to enable these men to indemnify themselves for their pecuniary outlay.

The limits of this traffic were quickly extended both northward and westward, and we find by reference to Delisle's map (1703) that the French then had a post (Fort des Abitibis) north of the height-of-land on the river Abitibi. This post, according to the memorial of Begon,[*] was the most advanced station of the French toward Hudson bay. From this same memorial it also appears certain that the route northward by way of Lake Timiskaming and the Abitibi river (Monsony or Monsipy) was one of the best known, although the French traders avoided the immediate vicinity of Hudson bay in order not to expose themselves to the insults of the Indians who were friendly to and traded with the English posts already established in that vicinity. It does not seem unreasonable to suppose, therefore, that some of the expeditions despatched by the Governors of Canada toward the close of the seventeenth century, to take possession of Hudson bay, adopted this well known route by way of the Upper Ottawa and Abitibi rivers. All the earlier maps indicate many of the streams flowing northward from the height-of-land into James bay with tolerable accuracy, thus showing that the early voyageurs were well acquainted with this portion of the country.

Fort Timiskaming must have been one of the first posts established by the Northwest Company, if not acquired after its abandonment by the French, for Mr. Roderic Mackenzie, a clerk in this Company, who wrote 'A General History of the Fur Trade,'[†] which forms the opening chapter of Sir Alexander Mackenzie's Travels in North America, says: 'Lake Timiskaming, where there has always been a trading post,' while one of the buildings which had been used as a storehouse and which was removed only a few years ago, bore dates on the large cedar beams which pointed to its erection some time near the close of last century.

Fort Timiskaming afterwards became the headquarters of the Hudson's Bay Company in this district, containing the residence of the Chief Factor and all the necessary adjuncts in the shape of buildings, &c., which usually go to make up a well equipped establishment, forming one of the most important centres of the fur trade, and containing, besides, a library embracing many volumes on science, travels and general literature. In 1888, however, this post, so long established, was abandoned, and a small store was erected at 'The Point' near the village of Baie des Pères, which was found more convenient for purposes of general trading; while the opening up of the Canadian Pacific railway had previously caused the removal of the headquarters to Mattawa.

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[*] Mémoire de Begon, Oct. 20 1725, qui explique les anciennes limites du poste de Témiscamingue.

[†] Voyages from Montreal through the Continent of North America to the Frozen and Pacific Oceans in the years 1789 and 1793. London, 1801. p. xxxiv.

Timagami post, now situated on the west side of Bear island on Lake Timagami, was moved to its present site in 1875, on account of the opening of an opposition fur-trading establishment owned by Alexander Dukis, who soon left his stronger rival in undisputed possession of the place. Before its removal thence this post was located on the shores of a small cove on the south side of Timagami island, and ruins of the buildings are still visible at this place. Fort Wrath, of which the tumbled-down buildings may even now be noticed on the east shore of Lake Timiskaming about a mile above Piché point, was built to overcome the rival post operated by Mr. Edward Piché, who still resides at his farm on the point which bears his name. This place was kept open for a few years only, when the necessity for its presence ceased. The somewhat important post near the mouth of the Sturgeon river continued actively engaged in trade with the Indians until the opening of the railway, when it gradually fell into disuse and was finally abandoned altogether about the year 1890. Hunters Lodge, originally a trading establishment, situated on Hunters narrows in Kipawa lake, was abandoned about the same time. At several points on the Ottawa river and the lower portions of Lake Timiskaming, temporary posts were erected from time to time, but these were of no permanent importance, and when the reasons which brought them into existence disappeared, they were given up and forgotten. Buildings originally erected in 1887, and designed for storage purposes on Bay lake, an expansion of the Montreal river, have since been raised to the dignity of a post with an officer in charge. At present, in the area of the accompanying map-sheets, there are only three establishments, Timagami, Bay lake and Long point (on 'Quinze lake'), which receive any great quantity of furs, although a considerable number of skins come in casually to the posts at Mattawa and Baie des Pères during each year. Of these Timagami is the most important, but the gradual opening up of considerable areas in this district to settlement, and the diminution in point of number both of the fur-bearing animals and the Indians who are chiefly engaged in their capture, is already having a marked effect, showing a gradual, or in some cases a rapid, decrease in the number of skins annually brought to market.

The opening chapters of Mackenzie's narrative, previously mentioned, give a brief description of the route generally pursued by the fur-trading canoes in gaining access to the various forts and trading posts of the interior. The rapids and portages of the Mattawa are enumerated, the names in most cases being the same as those in use at the present time, although the river itself is here called Petite rivière. Nepisingui (Nipissing) lake is also mentioned, and a short account given of the Rivière des François.[*] The first geological account of the region in question was that of Dr. J. J. Bigsby, who had come to Canada as medical officer to a regiment. About the year 1820 he received an appointment from the Colonial Government to make a general report on the geology of Upper Canada, the absurdly small sum of twenty-six pounds, as he informs us, being granted as pecuniary aid to carry out this extensive undertaking. Dr. Bigsby first made an examination of the Ottawa, Mattawa and French rivers, together with Lake Nipissing, having been granted a free passage to Sault Ste. Marie in one of the Northwest Company's canoes. He gives a good account of the Ottawa river itself and of the country adjoining this stream, and mentions that the Mattawa river, which was the western branch of the Ottawa, often called the Little Ottawa, was known as the Tessouac river by the Indians. The occurrence of crystalline limestones at the Talon chute is noticed, among other interesting facts. The position of 'La Ronde,' a Northwest Company's post, is noted as being situated at the mouth of the Vase river, as well as its subsequent removal to one of the islands in Lake Nipissing.[†]

During the progress of the magnetic survey of British North America, executed between 1842-1844 by Sir J. H. Lefroy, various observations were taken in this region to ascertain the magnetic variation, while latitudes were obtained at the following places: Hudson's Bay Company's post, Mattawa; First portage on Little (Mattawa) river, Lake Temisique (Lower Trout lake); Lake de Talon or Lake Walrond; Trout lake, formerly called Lake de Grande Vase; Height-of-land portage, towards Lake Nipissing; and Cross point on the south shore of Lake Nipissing, where a cross had been erected to commemorate some fatal accident.[*]

For many years the region in the vicinity of the Upper Ottawa river was comparatively unknown, except to the occasional traveller and missionary, and to those engaged in the fur trade, whose business necessitated constant journeying to and fro along the main canoe-routes. In time, however, the almost inexhaustible supply of valuable timber known to exist in this district attracted the attention of the enterprising lumberman, whose operations were so quickly extended northwestward that by the year 1845 we find that lumber camps were in full operation in the vicinity of the Opimika narrows (the 'Galère'), while some two or three years previously red pine timber had been cut on Lake Timiskaming several miles above the Narrows at the Hudson's Bay Company's post. These lumbering outposts, however, were for the purpose of cutting red pine alone, the value of which at this time caused it to be sought for at greater distances than the white pine; for previous to this no white pine had been cut higher than Bennett brook, on the Ottawa river.

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[*] See pp. xxxiv. and xxxv. Mackenzie's Voyages.

[†] Shoe and Canoe, vol. I. London, 1850. pp. 105 to 171.

[*] See Lefroy's Magnetic Survey of [illegible] Dominion of Canada. London, 1883.

The first really accurate delineation of the topographical features within the area comprised by the two accompanying map-sheets was made by Sir William E. Logan, the founder and first Director of the Geological Survey of Canada, in the year 1845.†

A geological section across the western part of Canada, from Lake Huron to Lake Erie, having previously been made by Mr. Alexander Murray, in 1843, in addition to an examination into the stratigraphical relation of the rocks comprising the extreme eastern portion of Canada, by Sir William Logan himself, it was considered expedient that a third section should be undertaken across and embracing some part of the northern district. The Ottawa river was chosen for various reasons, the chief of which was perhaps its accessibility and the greater immediate utility to the country at large which such a survey promised. Starting from Montreal he made an examination of the various rock formations exposed on the shore of the Ottawa, taking occasional short excursions inland wherever deemed necessary. This geological investigation was continued as far as the mouth of Bennett brook, about five miles above the 'des Joachim' rapids. As this was the highest point yet reached in the topographical delineation of the course of the Ottawa it was decided to make this the starting point of the contemplated survey of the upper portion of this stream. The distances were determined by the Rochon micrometer telescope, while the bearings and angles of intersection were obtained by means of a theodolite. The differences in level of the river at all the rapids were ascertained by careful levelling with a proper instrument and staff, the fall in the intervening stretches being estimated from a knowledge of the strength of the current. This survey was continued up the Ottawa as far as the first chute on the Rivière des Quinze, a short distance above the head of Lake Timiskaming. During the same season, and as a necessary adjunct, a similar survey was undertaken of the Mattawa river, from its junction with the Ottawa to its headwaters in Trout lake, including also the portage-route by way of the Rivière de la Vase to Lake Nipissing, as well as a small portion of the shore-line of this lake in the vicinity of the mouth of this inlet. Observations for latitude were obtained at the starting point, the mouth of the Mattawa, the mouth of the Vase on Lake Nipissing, as well as at the mouth of the Kipawa on Lake Timiskaming. In fact every precaution was taken to make this survey as accurate as was possible with the instruments and time at his disposal. The various topographical details, delineated in a map subsequently compiled by Sir William Logan himself on a scale of one mile to an inch, bearing valuable notes regarding the various rock formations encountered, is at present on file at this office, and although not issued as a separate publication, the information has been made use of in every subsequent map covering the district.

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†Report of Progress, Geol. Surv. Can., 1845-46.

A portion of the Ottawa river in the neighbourhood of the Mattawa, as well as the whole of this latter stream, were, however, incorporated in the atlas to accompany the report by Mr. Alexander Murray (1853-56). During the summer and autumn of 1854 Mr. Alexander Murray, of this Survey, was engaged in making exploratory surveys to the east of Lake Huron and Georgian bay. These included a survey of the southern shore of Lake Nipissing, from the point where the French River measurement ceased in 1847, to the mouth of the Vase, where connexion was made with Sir William Logan's survey of 1845, and thence of the north shore of this sheet of water to its 'northwest angle.'* In 1855 Mr. Murray continued this survey, commencing at the outlet of Lake Nipissing into the French river, along the western coast, making connexion with the work of the previous year.** In 1856 this survey was again extended, this time a start being made from the Hudson's Bay Company's post on Sturgeon river near Lake Nipissing.

Ascending the Sturgeon river for about fifty-two miles to the mouth of the Maskinongé, the measurements were carried up this important branch through Murray, Washkigamog, Maskinongé-wagaming and Mattagamashing lakes to Wanapitei lake, and down the Wanapitei river to Lake Huron.†

In 1855 Duncan Sinclair made a survey of Kipawa lake, with a view of defining and locating certain timber limits. This survey, although excellent for the purpose for which it was undertaken, nevertheless lacked certain details essential for a correct elucidation of the geological features, thus necessitating a re-survey, which was accomplished by Mr. J. F. E. Johnston of this Department.

Acting under instructions from the Commissioner of Public Works, Mr. Walter Shanley, C.E.,‡ in 1856-57 made a detailed examination of the route contemplated for a canal to connect the waters of the St.

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*Report of Progress, Geol. Surv. Can., 1853-56, p. 101 et seq.

**Report of Progress, Geol. Surv. Can., 1853-56 pp. 128 and 135 et seq.

†Report of Progress, Geol. Surv. Can., 1853-56, pp. 145 et seq.

‡Report of Walter Shanly, Esq., On the Ottawa Survey.—Toronto. March 22nd 1858. Also Report on the Ottawa and French River Navigation Project. —Published by order of the Montreal Board of Trade, 1863

Lawrence with those of the Great lakes by way of the Ottawa, Mattawa and French rivers, and Lake Nipissing.

In 1858-59 another examination of the same route was made by Mr. T. C. Clarke, C.E.,§ also in accordance with instructions received from the Commissioner of Public Works.

In 1867 Mr. A. G. Forrest, acting under instructions from the Crown Lands Department of Ontario, made a survey with transit and chain of the Montreal river, starting from its intersection with a due west astronomical line, supposed to be run on the parallel of latitude of 47° 56′, between Michipicoten harbour on Lake Superior and the head-waters of the Montreal river. This astronomical line was started about the same time from its eastern and western extremities. Mr. Duncan Sinclair, who was entrusted with the eastern portion of the line, succeeded in running a distance of 105 miles from the Montreal river, while Messrs. A. P. Slater and R. Gilmour ran eighty-four miles eastward from Michipicoten harbour. Mr. Forrest, from the intersection with Sinclair's line, made an instrumental traverse of the Montreal river to its mouth on Lake Timiskaming, a distance of one hundred and one and a quarter miles, at the same time taking notes on the timber and other natural resources of the country extending for three miles on either side of the stream. These surveys, commenced in 1866, were completed in 1867. Their primary object seems to have been to determine the feasibility of the construction of either a wagon road or railway to the Red River country through the district in question.*

About the same time, (June 13th to August 16th, 1867), Mr. Lindsay Russell made a micrometer traverse of Lac des Quinze and the Upper Ottawa, connecting with H. C. Symmes' survey of Grand lake. Mr. Russell during the same season made a similar survey of the route to Lake Abitibi, as well as a traverse of this large sheet of lake, then for the first time correctly measured.†

In 1871 Mr. Alexander McKenzie, acting under instructions from Mr. James H. Rowan, who had charge of the Canadian Pacific Railway surveys from the Mattawa to the Red river, made a track-survey northward by the Ottawa and Abitibi rivers to James bay, returning by way of the Moose and Michipicoten rivers to Lake Superior.‡

In 1871-72 Messrs. Lloyd, O'Hanly and Austen, also under Mr.

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§Return of Recent Survey and Report of the Engineer on the Ottawa Ship Canal. Quebec, 1860, by Thos. C. Clarke, C.E.

*See remarks on Upper Canada surveys, 1867 pp. 56-62.

†See Report Commissioner of Crown Lands, Quebec, 1868, p. 17, also descriptions of the Surveyed Townships and Territories of the province of Quebec, 1889, pp. 416-424.

‡See Progress Report on Surveys Canadian Pacific railway, 1872, p. 74. Also Report on Surveys Canadian Pacific railway, 1877, pp. 5-47 and 48.

Rowan's instructions, made exploratory surveys from Mattawa by way of the Ottawa and Montreal rivers to a point about half-way between this latter stream and one of the branches of Moose river.§

In 1872 Mr. Walter McOuat of this Survey was engaged in a geological examination of that portion of the country to the north and east of Lake Timiskaming. The work performed by Mr. McOuat in the Timiskaming region embraced a most painstaking geological examination of Rivière des Quinze, Lac des Quinze and the route thence northward to Lake Abitibi, including a micrometer survey of the shores and islands of that lake. He also made a micrometer traverse of the Blanche river as far as Round lake, accompanied by an examination of the rocks in the immediate vicinity of this stream.* The plans to accompany his report have never been published, but the information contained has been utilized in subsequent general geological maps embracing this area.

In 1872-74 Messrs. O'Hanly and O'Dwyer, joint commissioners for Ontario and Quebec, made an instrumental traverse of the Ottawa from Mattawa to the head of Lake Timiskaming, and surveyed a line running northward from a point on the 'Chenail du Diable,' near the mouth of the Rivière des Quinze as far as the height-of-land.†

During the year 1876, in connexion with the location of the Canadian Pacific railway, Mr. Marcus Smith, then acting engineer-in-chief, made an examination of the eastern portion of Lake Nipissing, as well as of the 'Beuve' (Veuve) river as far as the forks, about twenty-five miles from the mouth.‡

In 1879 Mr. W. A. Austen, for the Canadian Pacific railway, ran a trial location survey from a point situated a short distance (404 feet) east of the deep-water landing at Southeast bay (or East bay) of Lake Nipissing, in a northeasterly direction for sixty-three miles up the valley of the Sturgeon river.|| As a part of the same survey Mr. Austen made a micrometer survey of the Timagami river, the southern portions of Cross and Timagami lakes, as well as the route from thence to Maskinongé-wagaming lake, by way of Obabika and Wawiagama lakes.

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§See Progress Report on Canadian Pacific Exploratory Surveys, 1872. These surveys comprised Divisions B, C and D, respectively, mentioned in these reports. The surveys were begun on June 10th, 1871, and the last of them was completed by July, 1872. See also Report on Surveys, Canadian Pacific railway, 1877, pp. 5 and 47.

*Report of Progress, Geol. Surv. Can., 1872-1873 pp. 112 et seq.

†The manuscript plan of a scale of 40 chains to one inch bears the date, Dec. 27th, 1875, while the joint report filed with the Crown Lands Department, is dated Ottawa, Dec. 7th, 1874

‡Report Canadian Pacific railway, 1877, pp. 359-360.

Appendix 18, "Report Canadian Pacific railway, 1880, pp. 290-296." A plan on 4000 feet to an inch, detailing these explorations, as also two profiles of the Sturgeon river, are on file at the Department of Railways and Canals, Ottawa, and have been of much assistance in the compilation of the accompanying maps.

During the summer of 1884, commencing in June, Mr. T. Guerin, engineer of the Public Works Department, Ottawa, undertook an examination of the Ottawa river and Lake Timiskaming, with a view to ascertaining the feasibility, at a reasonable cost, of the various schemes urged on the government from time to time, looking to an increased facility in the navigation of these waters.

In the summer of 1884 Dr. Selwyn, during the progress of an examination of the numerous rock-cuts exposed along the line of the Canadian Pacific railway, paid a visit to the Manitou islands in Lake Nipissing, and the list of the fossils then collected from the Cambro-Silurian outliers comprising seventeen species, together with a few notes regarding their occurrence, was published by Dr. H. M. Ami.*

The Rev. J. M. Goodwillie, who was stationed at North Bay for some years, has made an extensive collection of the fossil remains from these islands, and these have now been examined and their identification has greatly added to the list appended to this report.

Mr. Ulrich determined a small collection of fossils for Professor N. H. Winchell, which were collected by Mr. T. D. Ledyard, of Toronto.† In 1889, Prof. N. H. Winchell paid a visit to North Bay, and gives a record of his observations made in that vicinity.‡

In 1889 Mr. G. K. Gilbert made an examination of the vicinity of North Bay and the country eastwards towards Mattawa, with a view to obtaining any evidence regarding the former existence of an outlet for the Great lakes immediately following the retirement of the ice-sheet. The possibility, and even the probability, of the existence of such an outlet had been looked upon for some time with favour by some geologists, although facts in support of these views were not forthcoming previous to the communication made by Mr. G. K. Gilbert to the meeting of the American Association for the Advancement of Science, held in Toronto in August, 1889. The general substance of the remarks then made was published under the title of 'The History of the Niagara river.'§

In September, 1892, Prof. G. F. Wright visited the neighbourhood

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Ann. Rep. Minister of Public Works, 1884-85, pp. 103-124.

*Can. Rec. Science, April, 1892, pp. 108 et seq.

†American Geologist, vol. XVIII., No. 3, September, 1896, p. 178.

‡Eighteenth Annual Report, Geol. and Nat. Hist. Survey, Minnesota, 1889, p. 501.

§Sixth Annual Report of the Commissioners of the State Reservation at Niagara for 1889, pp. 61-84, and reprinted in the Smithsonian Report for 1890, pp. 231-257.

of North Bay and Mattawa, making certain observations seemingly confirmatory of the former existence in the Mattawa valley of this outlet, embodying the results of his observations in a paper entitled, 'The Supposed Post-glacial Outlet of the Great lakes through Lake Nipissing and the Mattawa river.'

In the autumn of 1893 Mr. F. B. Taylor made some observations in regard to the occurrence of beaches in the vicinity of North Bay, and their relations to this supposed old outlet of the Great lakes. The results then obtained were communicated to the Geological Society of America, and published in the bulletin of that society.* In 1895 another visit was paid to the Nipissing district with the similar object of gaining additional information in regard to the recent changes of level.†

In 1896 a third visit was paid to the region in the neighbourhood of the Mattawa and Ottawa rivers, and the results then obtained were communicated to the Geological Society of America.

In 1890 William Ogilvie, acting under instructions from the Department of the Interior, Ottawa, fixed the latitude and longitude of Mattawa, the latter by telegraph from Ottawa.

In 1892 Messrs. H. K. Wicksteed and Patterson, under the direction of Mr. J. C. Bailey, C.E., of Toronto, made the location survey of the Nipissing and James Bay railway from North Bay to the Northeast Arm of Lake Timagami. Mr. Patterson had charge of the location of the southern portion of the line from North Bay to Marten lake, and Mr. Wicksteed of the northern part.

The building of the Timiskaming branch of the Canadian Pacific railway, and the surveys and levels made in connexion therewith, have been used in the present map and report, the information being kindly supplied by Mr. M. H. McLeod, the engineer-in-charge.

General Physical Features.

The general character of the country may perhaps be best described as that of an uneven or undulating rocky plateau, with a gentle slope towards the east and southeast. Although in detail the surface of this plateau is far from uniform, consisting of a succession of more or less parallel rocky ridges, with intervening valleys occupied by swamps or lakes, still the district as a whole has a general elevation varying from 900 to 1,200 feet above the sea. There are no very prominent hills, the highest seldom attaining a greater altitude than

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Bull. Geol. Soc. Am., vol. IV., 1893, with discussion by Dr. Robert Bell, pp. 423-426.

*Bull. Geol. Soc. Am., vol. V., pp. 620-626 with two maps, also American Geologist, vol. XIV., Nov., 1894, pp. 282-285.

†*Ibid*, vol. XVIII., August, 1896, pp. 108-120

300 feet above the surrounding region, while throughout most of the district hills of 50 to 100 feet in height are rather conspicuous topographical features. The highest land in the whole area is situated near the northwest corner of the Timiskaming sheet, immediately to the west of Lady Evelyn (Mus-ka-na-ning) lake, where a range of hills of which Maple mountain is the highest peak rises to the height of a little over 2,000 feet above the sea, according to Dr. Bell.

The influence exerted by the underlying rock on the general contour of the surface is perhaps nowhere better exemplified than in the region embraced in this report. In the southern and southeastern portions, where the prevailing rocks are the various gneisses and granites included as Laurentian, there are no hills of any great height, the general surface presenting, as usual, a rather monotonous succession of low rounded hills, with correspondingly shallow rocky valleys. In the northern and western portions, however, those areas in which the quartzites are present, as well as those in which the plutonic rocks, chiefly granite and diabase, are prevalent, rise into rather important elevations; while those regions which are underlain by the slaty member of the Huronian are on the other hand low and flat. A remarkable resemblance exists between the contour of the surface, occasioned by the presence of the diabasic rocks, and that produced by the heavy-bedded and massive quartzite that forms the highest member of the Huronian exposed in this district, both rising into comparatively high rounded or broken ridges, and rendering the stretches of country where such rocks prevail exceedingly rough and hilly. This is especially the case with the region to the north and northwest of Wakemika and Lady Evelyn lakes, and also between Friday and Whitebear lakes and the Montreal river; although the whole of the area coloured on the map as underlain by those rocks partakes essentially of this rugged character. This rough and broken contour is in marked contrast to the flat surface characteristic of the region in which the slates obtain.

The contrast is probably nowhere better shown than in the northeastern part of Lady Evelyn lake, where the quartzite which crosses the lake at the Obisaga narrows forms high and perpendicular cliffs for a short distance, while to the east, as far as the Waswaning narrows, the shore on both sides is low and swampy, with only a very occasional exposure of the flat-lying slaty rocks. At the elbow to the east of the Waswaning narrows a high ridge of diabase crosses the lake, forming rugged hills which constitute the western side of that portion of the lake known as the Mattawapika. Thus within a few miles, on the same lake, are exhibited examples of all three types of surface produced by the underlying quartzite, slate and diabase.

The large area coloured as granite, to the northeast of Lake Timagami, may perhaps be best described as a region of flooded *roches mountonnées*, for the hills are all low and rounded, while the intervening hollows are occupied by exceedingly intricate and shallow, swampy lakes or marshes. The valleys of the smaller rivers are usually narrow, and many of the streams are nothing but a succession of small lakes united by rapid rocky or bouldery discharging channels.

Probably one of the most interesting of the physical features presented by the district is the valley occupied by Lake Timiskaming and the Ottawa river. The greater portion of this valley is a very steep, rocky gorge, fringed on either side by lofty hills or perpendicular cliffs which rise abruptly to a height of from 400 to 600 feet above the surface of the water, while the average of a large number of soundings indicate that the lake has a mean depth of over 400 feet. The depression, therefore, occupied by these waters, would be about 1,000 feet below the level of the surrounding country, and as the bottom of the lake, wherever examined, consisted in the deeper portions of a very fine grey unctuous clay or silt, this depth may have been much greater before the accumulation of this material. From Mattawa to the mouth of the Montreal river these abrupt and rock shore-lines prevail, but above the mouth of this stream the lake undergoes considerable expansion and the shores exhibit a more gradual slope towards the surface of the water. The traveller ascending the Ottawa river is thus usually impressed with the mountainous character of the district, but an ascent of the hills on either side at once shows that the adjoining country is comparatively level, and that what appeared as ranges of hills are in reality the enclosing walls of this great valley.

The Mattawa and Montreal rivers, and in a lesser degree the Sturgeon and Timagami rivers, occupy rather deep and important depressions in this rocky plateau.

The district is traversed with rivers which are as important and well known as the lakes which they serve alternately as inlet and outlet. The Ottawa is, of course, the largest, but only a portion of this, from Mattawa to Lac des Quinze, is included within the area of the accompanying map-sheets. The Sturgeon likewise finds its source beyond the confines of this region, as also does the Montreal river, although by far the greatest portion of both streams is represented on the present maps. The Sturgeon is the larger of these two rivers, draining about 3,000 square miles, while the Montreal drains an area of about 2,500 square miles. The Matabitchouan, Mattawa, Kipawa, Timagami, Otter-tail and Otter rivers are also worthy of mention, although much smaller than the rivers first named. The

Blanche river is a stream of considerable size, but only a small part of the lower portion is included in the Timiskaming sheet.

In common with other regions characterized by the presence of Archæan rocks this district is remarkable for the number of lakes, both large and small, which are scattered over its surface. These lakes are in themselves noteworthy, not only for their many intricacies, but also because of the great number of islands which dot their surfaces. At first sight these lakes are seemingly governed by no law in regard to their distribution, but a somewhat closer examination reveals the dependence of geographical outline on the geological structure. In order to bring out more fully the intimate relation subsisting between the topographical outline and the nature and attitude of the enclosing strata, a careful compilation and correlation of the various strikes or direction of the foliation of the gneisses has been made, exhibiting with as close an approximation to the truth as is possible the various curves and folds assumed by these rocks.

The following nine lakes, with their areas and elevation above mean sea-level, may be particularly noted:—

	Area. Square Miles.	Height above sea
Lake Nipissing	345	640·5 647·8
„ Timiskaming	125	577·8 591·8
„ Kipawa	120	873·7 883
„ Timagami	100	964
Lac des Quinze	40	845
Lady Evelyn lake	18	930
Obabika lake	11	932
Obashing lake	11	822
Rabbit lake	8	938

Lake Timagami, during the earlier portion of the summer, drains both northward, by way of Nonwakaming and Lady Evelyn lakes into the Montreal river, and southward by way of Cross lake and Timagami river into the Sturgeon, the water thus ultimately finding its way into Georgian bay and Lake Huron. The southern outlet, however, is the larger and deeper stream, while the northern one is usually dry towards the end of July each summer, and is thus only utilized in time of high water. Rabbit lake finds its main outlet into the Matabitchouan river from the northeast corner of the lake, but a bay extending to the southeast is connected at extreme high water with Ross and Burwash lakes at the head of Macdonald creek, which in turn empties into the Matabitchouan river at the Fourth Bass lake. Annima-Nipissing lake, a large and important sheet of water situated between Lake Timagami and the Montreal river, which has usually, as the name implies, been regarded as the ultimate source of the Nipissing water, is 1,070 feet above the sea, while Breeches lake, which is in reality at the summit, is 1,085 feet above the sea. The highest lake in the whole region is Wilson lake, at the head of one of the branches of the Matabitchouan river, and this is 1,173 feet above the sea, while the height-of-land between this lake and the Montreal river is a little over 1,200 feet above the sea.

Denudation.

In many of the descriptions which have from time to time appeared concerning this, in common with other Archæan regions, undue prominence has been given to the erosive effect produced during the glacial epoch. The prodigious number of lakes both great and small which are so eminently characteristic of districts underlain by Archæan rocks have in general been referred to as original rock-basins which owed their existence to the excavating power of an immense glacier, while the mammillated hills and complementary valleys everywhere prevalent, as well as the constant occurrence of parallel grooves and scratches, have been adduced as additional evidence of the adequacy of the glacier to produce all the inequalities of the existing surface. The detailed examination of the region, however, amply demonstrates that the sculpturing to which the surface owes its present configuration was practically completed long before the advent of the glacial epoch, and that the main valleys, especially those of the Ottawa and Mattawa rivers, were in existence long prior to the deposition of the Palæozoic sediments.

In the first place the more important lakes and rivers occupy such deep and extended depressions that they seem inexplicable on any theory of glacial action or ordinary erosion by water. The bottom of Lake Timiskaming is on an average about a thousand feet below the level of the surrounding country, and in no place did the sounding lead reveal the original rocky bottom which has been more or less deeply covered by silts and by accumulations of drift material. Portions of the Mattawa and Montreal rivers are fully six hundred feet below the level of the rocky plateau through which they flow, and in many places exhibit steep, often perpendicular banks, composed of the hardest and most massive crystalline rocks.

Secondly, the trend of many of these valleys does not coincide with the general direction of the ice-flow, as revealed by the striæ and grooves which mark many of the exposed rock-surfaces of the plateau. These striæ in general vary from S. 10° W. to S. 30° W., while S. 20° W. may be assumed as a fair average of the direction of the ice-flow throughout this region. The deepest valley, that occupied by Lake Timiskaming and the Ottawa river from the mouth of Wabi creek to its confluence with the Mattawa river, has a direction of S.

30° E. while the valley of the Mattawa runs about east-and-west, thus forming considerable angles with the general striation, while the Montreal and Sturgeon rivers are intersected almost at right angles by these grooves and scratches. On the shores of Lake Timiskaming, and also on the Montreal river, many of the striæ exhibited have a direction corresponding with these valleys. These may either represent a differential movement in the mass of the ice itself, whereby the lower portion was forced by reason of its plasticity to conform to the inequalities of the existing surface while the upper portion continued on its general southwesterly course; or, as seems more probable, these grooves may have belonged to a local glacier occupying these valleys towards the close of the glacial period. On the upper or wider portion of Lake Timiskaming striæ belonging to the general glaciation may be noticed on the same rock-surface as other markings which belong to this local glacier, but the more abundant and strongly marked grooves throughout the lower portion of the valley are seen conforming to its various changes of direction.

Again, many of these valleys do not correspond with the strike of the rock in their immediate vicinity. The Ottawa valley is the best illustration of this fact, for the foliation of the gneissic rocks which compose most of its shores intersect this gorge almost at right angles. The depressions occupied by the Sturgeon and Montreal rivers also form considerable angles with the strike of the rocks in the immediate neighbourhood. Very often the streams occupy singularly straight and deep chasms in very hard rocks of different composition, valleys which it seems impossible that the ordinary erosive action of ice or water could ever have opened up, and which preserve their uniform direction with very little deviation in their course, even when the river has left a softer rock to enter an area where the hardest varieties prevail.

The Montreal river, from 'The Notch,' near its mouth, to the bend above the portage to Mud lake, a distance of twenty-one miles, flows through a rocky gorge, the course of which is in general N. 40° W. At this point the course of the valley changes abruptly to S. 45° W., which is maintained until Bay lake is reached, a distance of four miles. From this point upward a valley extends as far as the Great Bend, beyond the confines of the present map, which is almost if not quite parallel to that occupied by the river below Mud Lake portage. Of course the river presents many minor deviations in its downward course, but the remarkable uniformity in direction of the valley through which the stream meanders is maintained through successive alternations of slate, quartzite, greywacké and diabase, the character and composition of the surrounding rocks having apparently little or no effect in determining the course of this depression.

The existence, likewise, of Palæozoic outliers occupying portions of these valleys, seems ample proof of their existence as such from a very early time. The occurrence of an outlier of limestones, shales and conglomerates belonging to the Niagara was noticed by Sir William Logan on Lake Timiskaming in 1844. This outlier appears as a shallow syncline resting unconformably on the slates and quartzites of the Huronian. The conglomerate, grit and arenaceous limestones representing the basal portion of the section may be seen forming a narrow fringe from Piché point to Chief island, on the east side of Lake Timiskaming, while a small patch of similar rocks crops out on the west side from Haileybury northward towards Wabi bay. The limestones are present on the islands to the north of Bryson island, and on the peninsula between Sutton and Wabi bays extending beyond the limits of the present map. The boulder-conglomerate that occupies the eastern shore to the south of Chief island is composed of large angular or subangular blocks derived from the Huronian quartzite which forms rather abrupt hills immediately behind this exposure. These detached fragments doubtless represent what was originally a talus, formed at the foot of this steep slope, and when the submergence took place the intervening spaces became filled with detritus composed of the same materials, in a finer state of division, together with a small proportion of calcareous matter. This conglomerate and grit rest upon a surface which had clearly assumed a hummocky character before the deposition of these sediments, while the action of the glacier flowing down Lake Timiskaming long afterwards striated and polished the whole, leaving a surface with a net-like structure, through the meshes of which protrude rounded or ovoid sections of these rocky hillocks. Limestones and sandstones of Black River age are seen resting on the mammillated surfaces of Laurentian gneiss on the Ottawa, six miles below Mattawa, and also about five miles above Deux Rivières, as well as on the Manitou islands, Lake Nipissing, while sandstones which are probably of Chazy age, but which have yielded no fossils, were noticed on Iron island in the same lake.

The occurrence of such outliers at various points throughout these valleys shows that they existed in very early Palæozoic times, and indicate the transgression of the sea thus far inland at intervals during this, the Palæozoic, the submergence having been greatest during the Niagara, when the sea reached the northern end of Lake Timiskaming and may possibly have been connected by narrow arms and straits with that extending southward from Hudson bay.

The rounded or *moutonnée* surfaces of all these rocky elevations, though no doubt accentuated by later glacial action, have in the first place been due to the unequal progress of rock decay. The work of Lawson, Low, Coste and Laflamme,* who have during the progress of their several explorations made critical and extended examinations of the relations existing between many outliers of Palæozoic strata and the subjacent Archæan rocks, clearly shows that the mammillated surface long antedates the glacial epoch, and was as characteristic of the surface upon which the earliest Palæozoic sediments were deposited, as that upon which the great glacier rested in glacial times. The chief cavities, vertical precipices and deep, narrow gorges must have been determined by great transverse or lateral breaks. The causes which operated in their formation must have been in force with marked intensity long before the deposition of the Niagara, for as has been shown, the valley had been practically completed before the deposition of these sediments. The rounded contours of the rocky plateau and the intervening hollows doubtless represent the depth to which these crystalline rocks had undergone disintegration during the immense lapse of time while they were exposed to the action of the weather and other denuding agencies before the glacial epoch, while the ice simply removed the loose material resulting from such decomposition, smoothing and striating the rocky surfaces encountered.

Both quartzite and diabase, and sometimes also the massive slate (or greywacké) which occurs as a transition between the more fissile slate beneath and the quartzite above, frequently form cliffs from fifty to two hundred feet in height, the angle of slope being considerably lessened by a talus of angular blocks detached from above. Good examples of these quartzite cliffs are furnished by the shores on the west side of Lake Timiskaming, opposite Bryson or Moose island, at the Obisaga narrows on Lady Evelyn lake, as well as by the steep hills on the west side of Cliff lake, while the Manitou or Devils Rock on the west side of Lake Timiskaming, south of Haileybury, and the western shore of Timagami lake, opposite the Hudson's Bay post, are excellent instances of the vertical precipices produced by exposures of diabasic rocks. Prominent cliffs formed of the massive slate or greywacké may be noticed on the Matabitchouan river immediately above the Fourth Bass lake, as also on the west shore of Lady Evelyn lake, south of Wendabin bay. The action of the frost and weather is continually loosening large masses of these cliffs, which then fall with a great noise, and this phenomenon is so frequent that one of the lakes (Manito-pepagee), to the west of Lake Timagami, has received its name on the supposition that the Evil One was the cause of the disturbance.

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*Bull. Geol. Soc. Am., vol. I, pp. 163-173, also Annual Report, Geol. Surv. Can., 1882-83-84, part D.

Soil.

Although the district as a whole cannot be said to be suitable for agricultural purposes, still in many places considerable areas of good land are known to exist. The largest continuous tracts of such land are to be found in the vicinity of the northern portion of Lake Timiskaming on both sides of the lake, and thus both in Quebec and Ontario, although the larger proportion is in the latter province. The Crown Lands Department of Quebec has subdivided the two townships of Guigues and Duhamel and portions of four others, Fabre, Laverlochère, Baby and Neudlac. These by no means exhaust the arable land on this side, but are sufficient for the present requirements of settlement. On the opposite shore of the lake Ontario has laid out and divided into lots twenty-five townships which extend along the western side of the lake, and running in a northwesterly direction include the valleys of Wabi creek and the Blanche as far as Round lake. Only five of these townships and the southern portion of four others are included within the area covered by the accompanying map.

The area thus subdivided is in general composed of level or slightly rolling clay land. In some places the clay sub-soil is overlain by clay loam or sandy loam, while in other instances a rather barren yellow sand appears at the surface. In the province of Quebec, where the surface has in many places been almost completely denuded by repeated forest fires, this clay is best seen. From the Quinze river, a little south of Quinn point, large areas are covered with a thick mantle of stiff grey clay through which protrude exceedingly rough and prominent hills of quartzite, granite, diabase and breccia-conglomerate. These hills rise abruptly from an otherwise level clay plain, for the surface characterized by the presence of this clay exhibits a singularly flat appearance with only a gentle rise towards the base of the hills.

On the Ontario side the township of Lorraine is rough, rocky and broken, and for the most part unsuitable for farming purposes. Along the valleys and in the vicinity of Lake Timiskaming the soil is clay but these clay flats are of comparatively small extent. To the northwest, however, in the townships of Bucke and Dymond there are quite a number of farms, and a large area of cultivable land exists, so that the villages of Haileybury and Liskeard seem destined to become the centres of a considerable agricultural community.

The top of the limestone plateau which constitutes that portion of the Niagara outlier forming the promontory dividing the northern end of the lake is generally overlain by a light sandy loam soil, although in many places the underlying rock is destitute of any such covering. In the southwestern part of Dymond and the southern portions of Hudson and Henwood a series of rocky ridges of the Huronian slate occur. In the township of Henwood these ridges have a general north-and-south trend; while in the township of Hudson the slate rises into hills some of which are nearly 200 feet in height. North of these ridges, according to Mr. Hermon, the soil is white clay, the surface generally level and the appearance of the country flat and swampy.

Between Mattawa and North Bay, to the south of the Mattawa river, in the townships of Papineau, Calvin, Bonfield and Ferris, considerable areas of land exist which may be utilized for farming purposes, and their proximity to the line of railway makes these of value. Already these townships contain a large number of excellent farms and the region is rapidly becoming settled. The soil is usually a clay-loam, rather rocky and stony in places, but seems to yield excellent crops. In the vicinity of North Bay the land is sandy and light.

The valley of the Sturgeon, below the Timagami river, contains many wide and extensive flats which are susceptible of improvement, but above this stream the valley is much contracted and the flats decrease both in number and extent as the river is ascended, and towards the mouth of the Maskinongé river the country becomes much more broken and for the most part poor and rocky. Between Smoky falls and the mouth of the Timagami, the country in the vicinity of the river is tolerably level and composed of grey clay overlain by sand. The soil is for the most part a sandy loam and affords support to a thick growth of hardwood and evergreens, which by their sturdiness attest the good qualities of the soil beneath. Clearances have been made at intervals along the river, with the exception of that portion flowing through the Indian reserve, as far as the mouth of the Timagami. A short distance below the mouth of the Pike river, on the south side of the river, is an extensive farm cultivated for many years for the purposes of supplying the lumbering camps of Mr. J. R. Booth, and a road connects this depot with the Canadian Pacific railway at Cache Bay station.

To the west of Sturgeon Falls there are a large number of farms which continue up the valley of the Veuve river, almost as far as Warren station, where the valley becomes very narrow. The soil throughout the valley is a stiff grey clay, and as the vegetable mould overlying has been burnt off it has a tendency to cake in dry weather.

In the vicinity of Sturgeon Falls the soil is very sandy, but the clearances continue to the east as far as the boundary of the Indian reserve, and to the south almost to the lake shore, although the land in general in this direction is flooded during the spring freshets.

On the Montreal river, above Bay lake, there are large areas of arable land, especially between Bay lake and the Mattawapika. The region to the northwest is very flat and level, underlain by clay, and although swampy at present, would probably be easily drained or dry up when cleared. These areas are most likely continuous with similar tracts noticed to the southwest of the townships of Henwood and Hudson.

A large tract of country extends from the vicinity of North Bay and the southern part of the townships of Widdifield northward to the Opimika creek. The soil is in places sandy and in some spots considerable clay is present, but the whole of this stretch of country is covered by a mixture of hardwoods and evergreens, thus denoting a rather good soil beneath. The greater portion of the district, however, is extremely rocky and barren, the level areas being chiefly occupied by swamps, many of which would be difficult to drain, while the area thus drained would in most cases be insufficient for purposes of farming. Of the country surrounding Timagami lake and the greater part of the central portion of the area only small tracts would be available for purposes of settlement. The soil in general is extremely light, and without the aid of artificial fertilizers would soon fail to yield any adequate return. The rosy picture too often drawn of immense tracts of land available for agricultural purposes is to say the least very misleading, for apart from possible mining and its timber resources, by far the greater portion of the region will only be valuable as a health and recreation ground for tourists and sportsmen. The great tracts of forest as yet untouched by the axe, the vast number of picturesque lakes, both great and small, with fish and game in abundance, seem to render the district especially attractive for such purposes.

Climate.

In regard to the climate of the district as a whole, it may be said in a general way that the advent of spring is from three weeks to a month behind that of the region immediately surrounding the city of Ottawa, with a correspondingly earlier setting in of the winter. The winter is as a rule one of long continued and severe frosts, while the summer is proportionately shorter and much cooler than the country bordering the lower Ottawa. The average fall of snow in winter, as well as the rainfall during summer, is likewise considerably in excess of that in regions farther to the south.

Navigation generally opens on Lake Timiskaming about the end of the first week in May, although in occasional unfavourable seasons it is sometimes delayed a few days longer, while Kipawa lake does not usually break up until a week later. In 1893 the ice on the latter lake broke up and moved out between the 15th and 17th of May. Lake Timagami, which occupies the height-of-land between the waters flowing to Lake Timiskaming and those emptying into Georgian bay, being nearly 400 feet above the last-named lake, does not generally break up until the latter part of May, the lake usually being clear of ice about the 24th of May. The season of navigation closes, as far as Lake Timagami is concerned, between the 10th and 15th of November, while on Lake Timiskaming steamers have been known to make fairly regular trips within a few days of Christmas, although as a rule these boats cease running early in December.

The snow begins to melt about the middle of April, and has generally all disappeared by the 10th of May, although both snow and ice were noticed in secluded nooks and cracks along the sides of the precipitous cliffs on the west side of the Ottawa river as late as the end of May. Mr. C. C. Farr, formerly of the Hudson's Bay Company, and now postmaster of Haileybury, who has become identified with this young and flourishing settlement, states that 'seeding-time commences about the first week in May and ends, so far as oats are concerned, about the fourth of June, though oats have been sown as late as the 20th of June, and have done fairly well. Potatoes can be planted as late as the 20th of June, and it does not profit much to put them in before the 24th of May. Corn, cucumbers and melons can be sown about that date. Haying commences about the 11th July, harvest the 15th August.'

Summer frosts, so much dreaded by the farmers, especially in districts newly opened for settlement, have in the past proved a rather serious barrier to the successful raising of wheat, while oats have suffered severely, particularly in clearances situated some distance from the larger bodies of water. Frosts generally occur from the 18th to the 25th of August on the calm, clear nights following heavy north winds. In the vicinity of Lake Timiskaming the settlers often escape them altogether on account of their proximity to this large sheet of water, or their crops are but slightly injured, the more tender vegetables frequently being the only sufferers. The gradual clearing up of the land and the draining of many of the swamps will, however, materially mitigate this difficulty, particularly in the district in the vicinity of Lake Timiskaming, which is the area most suitable for extensive settlement.

The Native Inhabitants.

The Indians who reside within the area under description belong to the once numerous and powerful Algonquin family. They speak the Otchipew or Chippewa language, the same as that in use among the many bands which are scattered over the wide territory to the north and west of Lake Superior, with only a few minor alterations. They are divided into three bands known respectively as the Nipissing, Temiscamingue and Temagamingue bands. On June 30th, 1887, the census taken by the Department of Indian Affairs showed a total Indian population of 394, while on June 30, 1897, this population had only been increased to 430. The census taken in 1887 showed the following numbers in each band, Nipissing 165, Temiscamingue 136, and Temagamingue 93, while that taken in 1897 shows the population of the several bands to be, Nipissing 193, Temiscamingue 162, and Temagamingue 75. While, therefore, the total Indian population of the district shows a slight increase, one of the bands (Temagamingue) is slowly but surely decreasing. Two of the bands are comfortably settled on spacious reserves, but no tract of land has yet been allotted to the Temagamingue band. The Nipissing band resides chiefly in two small villages situated on the north shore of Lake Nipissing. The larger of these is about two miles west of North Bay to the south-west of Beaucage station on the Canadian Pacific railway, while the smaller one is located near the western boundary of the reserve, about four miles southeast of Sturgeon Falls. The Indians and associated half-breeds have built a considerable number of rather substantial dwellings, each with a small cultivated patch attached, on the northern bank of the Quinze river, forming the village or settlement of North Timiskaming.

Timber.

All the early explorers speak in terms of enthusiasm of the original great forests of the region here described. The most valuable tree from a commercial standpoint is the white pine (*Pinus strobus*), and in spite of the extensive operations carried on almost uninterruptedly by the lumbermen throughout a large part of this region during the past fifty years this tree is still present in considerable quantity. Next in importance and more abundantly distributed is the Norway or red pine (*Pinus resinosa*). In the early years of the lumber trade the greater value of this tree caused it to be sought for at more remote distances than the white pine, and thus we find at this time that camps for cutting red pine timber were many miles in advance of those erected for the purpose of securing white pine logs. The superior qualities of the white pine, however, soon came to be recognized and in time completely drove the red pine from the market, or so limited its sale that only a few of the finest trees were hewed down and utilized. Of late years, however, the marked diminution in size and quantity of the white pine has again brought the red pine forward, and both varieties are now cut without discrimination. The red pine seems to flourish on the apparently sterile sand plains, which are a feature in many parts of this district, and frequently forms exceedingly thick groves on the sides of hills where sand and gravel have collected, or on points composed of these drift materials which jut out into many of the lakes.

Jackpine, called by some pitch-pine, or bastard spruce (*Pinus banksiana*), is very often encountered in the more barren and rocky areas, and its presence seems an almost certain indication of the extreme poverty of the underlying soil. It is usually more or less scrubby or stunted in its growth, although occasionally, as in some areas to the northwest of Lake Timiskaming, it attains sufficient dimensions to be utilized for rough lumber. In the vicinity of the southern and eastern shores of Lake Nipissing the scanty groves of dwarf-like evergreens are almost wholly composed of this species, the hardy roots penetrating the various cracks and crevices of the rock. This tree also seems to select sandy or gravelly plains which have been overrun by fire and which had previously been occupied by a luxuriant growth of red or white pine.

Both white and black spruce (*Picea alba* and *Picea nigra*) are frequently met with, the latter being more abundant, but are too small to be of any commercial value for lumber, although many individuals would make excellent masts or spars.

White cedar (*Thuya occidentalis*) is usually found fringing the banks of streams or the shores of lakes, where it often forms a thick and at times an almost impenetrable undergrowth. Overhanging trees are frequently undermined by the waters or current during times of high water, and thus it happens that most of the drift-wood encountered belongs to this species. Its favourite haunt also seems to be the marshy hollows or flats which so commonly occur between the rocky hills, and extensive areas of swamps are almost entirely covered with a dense forest of this tree. As a rule the tree is small and more or less stunted in its growth, while the larger individuals are frequently hollow at the butt. To the north and northwest of Lake Timiskaming many fine speciments of this tree were noticed.

The white or canoe birch (*Betula papyrifera*) is also of very common occurrence, and together with the aspen poplar forms the prevailing second growth in areas which have been recently swept by fire. Both species in these instances form very thick groves of tall and straight though small trees. Interspersed with the more prevalent evergreen, especially where the soil is deeper and better, are occasional large trees which are of sufficient size to furnish good bark for canoes, as in the Sturgeon River valley, where good sized specimens may still be procured. The birch-bark canoes made on Lakes Nipissing and Timagami and at Mattawa have always been considered the very best of their kind both in build and material, but of late years the supply of good and suitable bark is becoming perceptibly less.

Three varieties of the poplar were noticed throughout the region, the balsam or rough-barked poplar (*Populus balsamifera*), the white or aspen poplar (*Populus tremuloides*) and the large toothed poplar or aspen (*Populus grandidentata*). The poplar sometimes forms stately trees, especially in the Sturgeon River valley and in the country to the north and northwest of Lake Timiskaming. Tamarack, sometimes called hackmatack and occasionally juniper, (*Larix americana*), is abundant, and in common with the cedar, and in a lesser degree the spruce, affects the low-lying areas or those portions of the forest where moisture may be readily and constantly secured. The immense tracts of swampy land between the headwaters of the Tomiko and Ottertail rivers to the north of the Spruce lakes contain an abundant supply of good sized specimens of this tree, and it is constantly met with all through the region whenever the conditions are favourable to its growth.

The balsam or fir (*Abies balsamea*) is one of the most common in the moist areas. Hemlock (*Tsuga canadensis*) was noticed northward to the Indian portage-route to Kipawa lake, a short distance below the mouth of the Kipawa river, but no specimens were observed as far north as the Old Fort narrows. It occurs rather abundantly and of large size in the vicinity of Lake Nipissing and on the Sturgeon river, but was not remarked in the northern and northwestern portions of the region. The basswood or linden tree (*Tilia americana*) was occasionally noticed on the Sturgeon river, while Sir William Logan mentions individuals two feet in diameter, associated with black birch and maple of similar dimensions, in the hardwood strip of country extending from behind the hills north of Trout lake at the head of the Mattawa river to the Opimika narrows on Lake Timiskaming. The basswood was also noticed mixed with maple, elm, poplar and balsam near the mouth of the Blanche at the north end of Lake Timiskaming.

The American yew, sometimes called ground hemlock (*Taxus baccata* var. *Canadensis*), is an exceedingly common shrub, and is particularly noticeable, as when present it often forms an almost impenetrable underbrush. Alder and willow of several varieties are present in the various swamps or lining the banks or shores of streams and lakes.

Although nearly all the principal varieties of hardwood are found in this region the proportion which such trees bear to timber of a softer description is quite insignificant. Of the maple family perhaps the most abundant is the sugar maple (*Acer saccharum*), which is frequently of large dimensions. The soft maple (*Acer rubrum*) is also present in large quantities, but the black or bird's eye maple (*Acer nigrum*) is only rarely met with in the valleys of the southern portion of the region. The mountain maple (*Acer spicatum*) is one of the common varieties in moist ground, while the striped maple (*Acer pennsylvanicum*) was noticed in many places. This tree is often called moosewood, because the green and juicy tops form a favourite food for the moose, although the true 'moosewood' (*Dirca palustris*) was noticed in many places suitable to its growth.

Large trees of yellow birch (*Betula lutea*) were remarked throughout the region, especially in the vicinity of the northern end of Lake Timiskaming, while specimens of the black or cherry birch (*Betula lenta*) were seen over thirty inches in diameter in the region to the north of the Mattawa river. The blue oak or swamp white oak (*Quercus macrocarpa*) is the most abundant of the oak family, and its favourite haunt seems to be the alluvial flats or intervals along the banks of streams where the soil is sufficiently moist and fertile. Here it is associated with the white elm (*Ulmus americana*), which forms large and beautiful trees, and the black or water ash (*Fraxinus sambucifolia*) [illegible] hite oak (*Quercus alba*) seems to delight in lighter and drier [illegible] good specimens were seen growing in the vicinity of Fort Tim[illegible]ng. The red oak (*Quercus rubra*) was also noticed in places as far north as our explorations extended. Ironwood (*Ostrya virginica*) is tolerably abundant and good. Specimens were noticed growing with the American beech (*Fagus ferruginea*) in the strip of hardwood land about five miles west of the Opimika narrows on Lake Timiskaming.

Of the wild fruits the thimble berry (*Rubus villosus*) is only very sparingly represented, if at all, in the southeastern portion of the district on the Ottawa, but the red raspberry (*Rubus strigosus*) is abundant on all negl[illegible] clearings, or in areas which have been burnt, and in the vicinity of deserted lumber camps. The wild grape (*Vitis riparia*) was seen growing on Mann island, Lake Timiskaming, as well as on several islands of Lake Nipissing. Both varieties of the low-bush cranberry (*Oxycoccus macrocarpus* and *O. vulgaris*) are found on many of the marshes which are so prevalent around Lake Nipissing. The former species is the variety generally collected, and the extensive swampy flats in the vicinity of the mouth of the Sturgeon river on Lake Nipissing are the principal localities for these berries. They formerly were a source of considerable revenue to the thrifty Nipissing band of Indians, who took them in barrels down to the French river to sell to the traders on Lake Huron. Several barrels of the smaller variety of cranberry (*O. vulgaris*) were sent to Toronto, but did not command a sufficient price even to pay expenses.

The high bush cranberry (*Viburnum opulus*) grows in damp ground along the river-valleys or on the margins of lakes where the shores are low. The bushes are sometimes between ten and twenty feet in height, and are especially abundant on Devil channel at the head of Lake Timiskaming, on the shores of Mann island in Lake Timiskaming, and fringing the banks of the Little and Ottertail rivers farther to the south. The two varieties of blueberry commonly met with (*Vaccinium canadense* and *V. corymbosum*) are present on all surfaces which have been lately swept by fire, and the Indians have been known to set fire to some of the smaller islands in order to get a supply of this fruit. *Vaccinium canadense* prefers the drier and more rocky locality, but is also frequently noticed in swampy flats directly exposed to the sun's rays, while *Vaccinium corymbosum* with less abundant though much better and larger fruit, prefers a deeper and richer soil as well as localities which are more in the shade.

Fauna.

Of the deer tribe the most abundant are the moose (*Alce americanus*) and the red or Virginia deer (*Virginianus cariacus*). Owing to the recent provisions made by the Ontario Government looking to their preservation, aided no doubt by the advance of settlement to the south, these animals have become exceedingly numerous. The moose in particular is abundant, and their 'runways,' especially in the vicinity of rivers and lakes off the frequented routes of travel, are usually better beaten than many of the cattle paths in the neighbourhood of considerable settlements. This is notably the case on the Ottertail river, which flows into Lake Timiskaming from the west about four miles above the Opimika narrows on the small stream connecting Boice and Wicksteed lakes, as well as on the lower part of the Montreal river. It is only within the last ten years that the red or jumping deer have become at all numerous, and before 1887 only occasional specimens were shot, but now every sandy beach in the more secluded portions of the region is covered with the imprints of the feet of these animals.

The wolf (*Canis lupus*) has likewise become rather common, although a few years ago it was rarely if ever encountered. This animal follows very closely the migrations of the deer.

Both moose and red deer are gradually moving northward and northwestward, the former being met with in the vicinity of Abitibi lake where previously they were unknown, while occasional specimens have been shot, according to Mr. A. P. Low, close to Moose Factory on James bay.

The woodland caribou (*Rangifer caribou*) is not at all abundant, and chiefly inhabits the region to the north and northeast of Kipawa lake, becoming more numerous to the northeast. The black bear (*Ursus americanus*) is still a rather common animal, but the constant demand for and ready sale of the skins has led to their diminution.

Specimens of the fox (*Vulpes vulgaris*) are encountered and the skins find a ready sale. The Canada lynx or wild cat (*Lynx canadensis*) is likewise found, but only occasionally. The otter (*Lutra canadensis*) and the beaver (*Castor fibre*) are fast becoming extinct in this region, although signs of their presence may still be seen on many of the less frequented streams and ponds.

The fisher (*Mustela pennantii*), the sable or marten (*Mustela americana*), the stoat or ermine (*Putorius ermineus*), the mink (*Putorius vision*), and the muskrat (*Fibre zibethicus*) are also met with, and the two last-named are still abundant in the region. The skunk (*Mephitis mephitica*) is very common, especially in the vicinity of the settlements or lumber camps, where they come to feed on the rubbish thrown from the kitchen.

The porcupine (*Erethizon dorsatus*), ground hog (*Arctomys monax*) and the hare or rabbit (*Lepus americanus*) are also common. The chipmunk or striped squirrel (*Tamias striatus*), the red squirrel or chickaree (*Sciurus hudsonius*) and the flying squirrel (*Sciuropterus volucella*) are likewise common throughout the district.

No special attention was devoted to noting the presence or habits of the birds of the district, but a few observations regarding the most noticeable ones may be of interest. Ducks are as a rule comparatively scarce throughout the greater part of the area, chiefly because of the marked absence of wild rice, their favourite food, and the somewhat rare occurrence of open marshes, their customary habitats. There are, however, several very notable exceptions to this rule, and the shallow swampy bays which characterize the west portion of Lake Nipissing, the northeastern extremity of Shabosagi or Wicksteed lake, as well as the northern end of Lake Timiskaming, are favourite resorts for a rather large number of ducks during certain months both in the spring and autumn. During the summer months it sometimes happens in passing over the less frequented routes that occasional specimens of the black duck (*Anas obscura*) and the wood duck (*Aix sponsa*) are met with.

The merganser or saw-bill (*Merganser americanus*) is a very familiar sight along the numerous waterways, especially at the foot of small rapids.

Occasional specimens of the pied-billed grebe or dabchick (*Podilymbus podiceps*) were also met with. The great northern diver or loon (*Urinator imber*) is also a common inhabitant of the district. With few exceptions each of the small lakes has a pair of these birds, while in the larger expanses of water every individual bay or arm contains two loons, who year after year return with great regularity to the same locality for breeding purposes.

The osprey (*Panidion haliäetus carolinensis*) was frequently noticed, the nest being usually situated on the very summit of a lofty white pine 'rampike.'

The herring gull (*Larus argentatus smithsonianus*) is also one of the most abundant birds of the lakes of this region. Its nesting place is usually on bare rounded hummocks of rock, almost completely destitute of soil or vegetation.

The raven (*Corvus corax principalis*) very often builds on the inaccessible ledges of the high rocky perpendicular cliffs. Some of the principal localities where these birds have nested from year to year are—the Roche à Corbeau and 'The Canal' on Lake Kipawa, the west side of Lady Evelyn lake, the Crow Rock in the northern part of Annima-Nipissing lake and other places where the cliffs are high and sufficiently steep. The belted king-fisher (*Ceryle alcyon*) is constantly seen along the margins of creeks and rivers. The ruffed grouse or birch partridge (*Bonasa umbellus togata*) is very common, as is also the Canada grouse or spruce partridge (*Dendragopus canadensis*). Both the white ptarmigan (*Lagopus lagopus*) and rock ptarmigan (*Lagopus rupestris*) are also occasional visitors to this district.

Fish are exceedingly abundant in nearly all the lakes. The largest fish met with is perhaps the lake or rock sturgeon (*Acipenser rubicundus*) although many individuals of the lake trout nearly equal the sturgeon in size. The sturgeon was formerly a rather abundant inhabitant of Lake Nipissing, but of late years, owing doubtless to the increase in the number of settlers, is less common there.

From an economic standpoint, however, the lake trout (*Salvelinus namaycush*) and the whitefish (*Coregonus clupeiformis*) are the most important, as they are not only abundantly and widely distributed throughout the larger lakes of the district, but form a usual and valuable article of diet among the scattered settlements. Both these fish, although present in considerable quantity in Lake Nipissing, attain their largest dimensions in the clear depths of Lake Timagami. There are no trout in Lake Timiskaming or the Ottawa river or even in Lake Kipawa, although most of the lakes immediately tributary to these contain abundant and fine specimens of these fish. The brook trout (*Salvelinus fontinalis*) although comparatively rare is rather widely distributed, and its presence in any stream or lake is a sure indication of unusually clear and cold water. The small lakes to the west of the Mountain rapid on the Ottawa contain them in abundance, while they are exceedingly numerous in the Opimika creek and the lakes which this drains, especially Emerald lake. Latour creek, which empties Trout lake, in the township of Lorraine on the west side of Lake Timiskaming, has always been a favourite fishing resort for the inhabitants of the Hudson's Bay Company's old post, although the largest and finest specimens of this fish in the whole region may be procured in the streams entering Willow Island lake to the west of Lady Evelyn lake.

Closely allied to the whitefish is the fresh-water or lake herring (*Coregonus artedi*), which is somewhat abundant in many of the lakes.

Next in importance to the trout and whitefish are the various species of bass and sunfish which, with the exception of the black bass, do not attain to any great size. The black bass are of excellent quality and exceedingly plentiful, these fish being found in most of the lakes comprised within the area of the map-sheets. Both species, the large-mouthed and small mouthed, (*Micropterus salmoides* and *M. dolomieu*) are present. There is an extreme variability in point of colour which is clearly owing to the nature of their surroundings. In lakes and streams where the water is of a prevailing brownish tint the bass have a correspondingly dark hue, while in the clear, greenish water of Lake Timagami and Little lake, to the east of the Old Fort narrows, the bass have a pale-green coloration. This variation in hue is not a peculiarity affecting the bass alone, but may be also noticed in the trout, pike and especially in the pickerel. The finest specimens of these fish may be secured in Lady Evelyn lake (which contains no trout), Timagami, Red Cedar, Annima-Nipissing, Whitebear, Net and Rabbit lakes, although these by no means exhaust the list; while on Lake Timiskaming and Little lake, though not so abundant, the specimens obtained are generally of very large size.

The rock bass or red eye (*Ambloplites rupestris*) and the common sunfish (*Lepomis pallidus*) are also extremely numerous where conditions are favourable.

The common yellow perch and the pike-perch or pickerel are closely allied forms. The yellow perch (*Perca americana*), although of good quality is generally small, rarely attaining over one pound in weight, while the average size is very much smaller. It is not of economic importance as a food fish like the pickerel. The pickerel (*Stizostedium vitreum*), called by the French doré, is possibly next to the trout and whitefish the most valuable food fish found in the region. During several weeks of summer (generally in August) these fish retreat to the deeper water of the lakes, but at other times they may be readily secured in large numbers either by means of nets or with hook and line. At the Old Fort narrows on Lake Timiskaming it is by far the most abundant fish. It is also present in most of the other lakes throughout the district, especially in Lakes Kipawa, Obashing and Timagami The general weight is from four to seven pounds, but one caught by us on White-bear lake weighed fifteen pounds, while another from Hunters Lodge narrows on Lake Kipawa measured twenty-seven inches in length.

Both the common pike (*Esox lucius*) and the great pike or maskinongé (*Esox nobilior*), are found, although the former is by far the more abundant. The pike is a very common inhabitant in nearly all the lakes, while the maskinongé is comparatively rare, although several individuals were caught at the Old Fort narrows on Lake Timiskaming.

The common eel (*Anguilla rostrata*) is also present in many of the lakes, particularly Timiskaming and Timagami. Other fishes which might be mentioned are several species of sucker, the common cat-fish (*Amiurus nebulosus*) and the silver chub (*Semotilus corporalis*) but none of these are of economic value.

While most of the lakes are very abundantly supplied with fish there are some which deserve special mention. Timagami, Annima-Nipissing, White-bear and Rabbit lakes are *par excellence* the waters in which both trout and whitefish are found in greatest quantity and best quality, while the bass, pickerel and pike are also of large size and excellent quality. Lady Evelyn and Timiskaming lakes contain no trout. The Opimika and Old Fort narrows on Lake Timiskaming have always been and still are excellent fishing places, the fish chiefly caught being pickerel, pike and bass. Pickerel are caught in great numbers in the spring above the dam on Lake Kipawa near the outlet of the Kipawa river, as well as Hunters Lodge narrows, while the Narrows on Obashing lake is also a favourite resort for these fish.

GEOLOGY.

GENERAL STATEMENT.

The several geological systems and formations represented in the region covered by the accompanying map-sheets and subjacent to the Pleistocene superficial deposits may be thus stated in descending order:—

PALÆOZOIC
- SILURIAN—*Niagara.*
- CAMBRO-SILURIAN—*Trenton.*
  - *Birdseye and Black river.*

ARCHÆAN
- HURONIAN.
- LAURENTIAN—*Diorite-gneiss and granite-gneiss or "Fundamental gneiss."*

The Archæan rocks of the region here described may naturally be separated into two great subdivisions, that of the so-called Lower Laurentian and the Huronian, although a few small isolated inliers of crystalline limestone, and one at least of a dark-grey, exceedingly squeezed and altered gneissic rock are found to be enclosed in the ordinary granitic and dioritic gneisses. These are unimportant in this district, and so small in area that it has not been possible to distinguish them separately on the map. They resemble very closely rocks which in regions farther to the south and southeast are known as the Grenville series. The present report, therefore, does not include any discussion of the relations of the rocks classed as Huronian with those of the Grenville series. These two series do not come in contact in this area, and the question of their relations is at present being made the subject of special investigation in central Ontario.

Under the name Laurentian, in the area here described, are included a great number of varietal forms of granitic and dioritic materials, having essentially the chemical and mineralogical composition of such rock-types, but differing in their foliated texture, a difference which although almost invariably present is sometimes obscure and occasionally fails altogether. Their subdivision in the present report is based solely on their petrographical and mineralogical characters, for although their prevailing foliation, frequently marked by alternating bands of varying composition and colour, resembles in some respects an original stratification, it has been found impossible to make any such stratigraphical subdivision corresponding to that of later and truly bedded formations.

Detailed investigations both in the field and with the microscope, by various geologists and petrographers, have of late led to the belief that most of these gneisses have an origin in common with their more massive equivalents, and that the prevailing foliated character has been imparted to the rock-mass by differentiation in a slowly cooling magma of more or less heterogeneous composition, or as a result of deformation by pressure after the rock had undergone either partial or complete consolidation. The cogency of the arguments which have been urged in favour of the recognition of the greater part, at least, of these rocks as foliated irruptives now seems beyond question.

Every recent report aiming at scientific accuracy is necessarily prefaced by an apology or explanation of the use of the term Laurention to include such gneissic rocks of irruptive origin, that have been in a molten or plastic condition at a time subsequent to the deposition and hardening of later truly stratified rocks with which they are intimately associated and occasionally interfoliated.

It must, therefore, be clearly understood that in placing the rocks here representing the Laurentian at the base of a table such as that just given it is not intended to indicate that they stand for any distinct or prolonged lapse of geological time, nor to affirm that these rocks as a whole, in their present condition, and with the foliation they now possess, really antedate those of the Huronian system. This, it will be shown, is not the case in many, if not in most instances where a question of the kind can be determined.

The fundamental gneiss is here, therefore, accorded a priority in description to which it is not structurally entitled, as it may possibly represent in great part the first-formed crust of the earth, which, necessarily thin and fragile, and so liable to frequent upwellings of the molten mass beneath, has undergone successive fusions and recementations before reaching its present condition. As at present mapped it is regarded as a complex of irruptive plutonic rocks, representing repeated and intricate intrusions of basic and acidic material. Although in many instances, and in limited areas, the succession of such irruptions can be ascertained with tolerable accuracy, any attempt to correlate this succession in detail over extended areas has invariably ended in more or less complete failure.

In general, however, it may be stated that the earliest secretions of the magma from which these rocks have solidified consisted of a series of granitic and dioritic gneisses, very evenly and distinctly foliated, varying in colour from reddish through reddish-grey and grey to dark green and almost black.

These gneissic rocks were subsequently invaded by a massive, deep-red biotite-hornblende-gneiss that usually possesses a more or less distinct foliated structure, marked by the parallel alignment of the bisilicate minerals. It seems highly probable, however, that no great lapse of time intervened between these successive irruptions, as the latter in all probability represents the residual portion of the magma, necessarily more acidic and homogeneous in composition. Dikes of coarse pegmatite, as well as of fine-grained aplite, cut the different varieties of gneissic rocks or are frequently interfoliated with them.

To the northeast of Lake Timagami there is a large area of flesh-red granite which in many places, especially in the vicinity of Carrying and Annima-Nipissing lakes, has a distinct foliated structure. In appearance, composition, and behaviour it has so close a resemblance to similar rocks mapped as Laurentian farther to the south that it is proposed to include it with these rocks.

Between Timagami and Rabbit lakes there is a somewhat similar granite, which, however, is continuous with the main Laurentian area to the south, and is accordingly designated by the same coloration. In both cases these rocks pass by insensible gradations into a medium-textured dark-green gabbo or gabbro-diorite, with which they are intimately associated, by an increase in the plagioclase and the preponderance of hornblende as the coloured constituent. Although in the accompanying map these gabbro masses are shown in the colour usual for such basic intrusions it must be borne in mind that they are believed to represent basic portions or segregations of the same magma that has elsewhere crystallized as granite.

The Huronian rocks are generally clastic in composition, appearance, and microscopic structure, and in this respect are in marked contrast, even in their most altered phases, to those described as constituting the Laurentian of the district. A large proportion of these stratified rocks indicate the existence of intense and widespread vulcanism, which evidently characterized this period; their composition and structure showing a most intimate association of undoubted volcanic ejectamenta with material resulting from the ordinary processes of erosion and sedimentation. The breccia or breccia-conglomerate which is so abundantly represented, and here forms the basal member of the Huronian, is composed chiefly of angular, sub-angular, or rounded fragments of red grey granite, diabase of different degrees of texture, and various fine-grained slaty and hälleflinta-like rocks, embedded in a fine-grained, often argillitic matrix, consisting of similar material in a much finer state of division, with chlorite and sericite filling the smaller interstices.

In earlier reports on these rocks the much greater relative abundance of the granitic fragments, coupled with the somewhat distinct foliation observable in a few of these, was evidently taken to be sufficiently strong and positive evidence to justify their description as strata resulting from the degradation of the Laurentian gneisses and granites. The more detailed and critical examinations made during recent years, covering the country between Lakes Huron and Timiskaming, show, however, the error of such a conclusion in any wide or general sense. Thus the rock first described under the name of 'chloritic slate-conglomerate' by Sir William Logan must be regarded as essentially of pyroclastic origin, the volcanic ejectamenta having been evidently spread out upon the bottom of a shallow sea, where they have undergone in many instances considerable attrition and re-arrangement by water. Much of the coarser material cannot be correlated with anything now known to be present at the earth's surface in this region; while the intimate association of this rock with diabase and gabbro intrusive masses, rather than with the granites, reveals a close genetic relationship subsisting between these rocks that cannot be regarded as merely accidental.

Throughout the area, the Huronian, where fully represented, is separable into three distinct subdivisions which are, in ascending order, as follows:—(1.) *Breccia or breccia-conglomerate.* (2.) *Greywacke shale or slate.* (3.) *Feldspathic sandstone or quartzite.*

As a rule the lowest number, or breccia-conglomerate, presents only obscure evidence of stratification, and wherever such was visible the rock occurs in thick massive beds showing only a slight inclination or dip. This may be well seen in the hills on either side of Lake Timiskaming between the Montreal river and the Old Fort narrows. Where subjected to pressure, however, as is very frequently the case, the cleavage-foliation thus developed is a much more prominent structural feature and is thus very often mistaken for the bedding. This is especially the case in the region immediately adjacent to Lake Timagami where this rock is very widely exposed, and where it is associated with and squeezed between large masses of diabase and granite.

Superimposed upon this, and forming a transitional rock upwards into the succeeding subdivision, are beds of varying thicknesses of greywacke or feldspathic sandstone, less massive in structure while the coarser fragmental material gradually disappears as an ascent is made in the series. The succeeding shale or slate which is in general very similar in composition to the greywacke or the finer matrix of the breccia-conglomerate beneath, is often beautifully banded in varying shades of green, purple or brown. The cleavage in most cases corresponds with the bedding, although occasional instances were noticed where cleavage or jointage planes were developed at considerable angles with this bedding. Superimposed on this slate, in many parts of the area, is a very massive much jointed quartzite or grit, generally sea-green in colour because of the abundance of minute scales of sericite distributed through the finer portions of the rock. Occasionally, however, it has a reddish tinge, and the arkose then closely resembles a granite, both in composition and appearance. The rock is so massive that it is often only by the parallel alignment of certain coarse quartzose and other fragments that the original bedding can be distinguished. These various members of the Huronian here follow one another in regular and often nearly horizontal succession, except in the vicinity of the large igneous masses, where they show considerable evidence of disturbance as well as of alteration.

The Palæozoic rocks represented in this area consist of outlying patches of the following formations:—(1) *Birdseye and Black river* (2) *Lower Trenton*, (3) *Niagara*.

The outliers representing the Birdseye and Black River formation are exposed on some of the islands composing the Manitou group in Lake Nipissing. These are of very limited extent and consist of sandstones, limestones and shales, the whole section probably not exceeding thirty feet in thickness.

Some small exposures of sandstones and arenaceous limestones occur overlying unconformably the gneissic rocks of the Laurentian on the Ottawa river below Mattawa. The fossils secured from these thin exposures indicate that the containing rocks are of lower Trenton age, and thus somewhat higher in the stratigraphical succession than those occurring on the Manitou islands.

The Niagara formation, as exhibited in this district, is composed of light-buff or cream-coloured limestones and shales, with a basal boulder-conglomerate, or sandstone, unconformably overlying the Huronian slates and quartzites on the shores and islands of the northern portion of Lake Timiskaming. The strata composing this formation form a low, shallow, synclinal trough.

The coarser varieties of drift material, such as boulders, gravel and sand, are rather abundantly represented on the higher grounds, the surface being everywhere more or less encumbered with the larger erratics, especially on those slopes facing southward, while the comparatively shallow and rocky intervening valleys are frequently filled with coarse yellow sand, sometimes derived mainly from the decomposition of rock almost *in situ*. These boulders are usually of rock types prevalent in the district, but some show carriage from considerable distances. With the exception perhaps of the Mattawa, Nipissing and Timiskaming valleys there is little or no clay present in this district, the flatter details of topographical outline being given chiefly by deposits of coarse yellow sand. In the Timiskaming valley there is a thick and extensive deposit of a stiff, stratified, grey clay which in many places effectually conceals the rock beneath. This c occurs in flats of considerable area, through which the various strea have cut deep and tortuous channels, while protruding through th clay plains are steep and rocky hills of the prevailing types of Huronian strata. In the wide depression, the deepest and m northern portion of which is occupied by the Mattawa river, a which has also been utilized in the construction of the Canadi Pacific railway, the minor valleys, and often too the separati rounded rocky elevations, are covered by clay deposits containing considerable intermixture of boulders.

In the vicinity of North Bay and Sturgeon Falls a considera depth of coarse and yellow sand is present at the surface, conceali the grey clay beneath; but at the west of Sturgeon Falls, especia in the vicinity of Verner, the stiff, grey, stratified clay comes to t surface, forming flats which have been burnt over or cleared. So f no fossils have been found in these clays, although in places dilige search was made for any such evidence of their origin, especially the hard concretionary nodules which may be occasionally noticed.

The areas covered by the several rock formations may be stat roughly as follows: On the Lake Nipissing sheet there are about 3,1 square miles of Laurentian, and 270 square miles of Huronian, wh on the Lake Timiskaming sheet there are only 946 square miles Laurentian, 2,470 square miles of Huronian and associated eruptiv and forty square miles of Silurian. The two sheets combined, ther fore, show 4,132 square miles occupied by Laurentian, and 2,740 squa miles by Huronian and associated granites and diabases. The Siluri covers about forty square miles, but extends northwestward to a co siderable distance beyond the northern confines of the Lake Timi kaming sheet. The aggregate area of Cambro-Silurian strata expos on Lake Nipissing and Ottawa river is less than two square miles.

LAURENTIAN.

The name Laurentian was originally proposed by Sir Willia Logan, in 1853, as the most appropriate designation for rocks class fied by him in previous reports as the 'Metamorphic Series,' an which were believed to be identical in composition and origin wit similar rocks so named and described by Lyell. The term thus intro duced soon received an almost universal adoption by geologists, as convenient one for the gneissic crystalline rocks found to underli unconformably the Palæozoic strata, and presumably forming th oldest of the geological systems. The urgent need of such a distinctiv appellation was recognized as a consequence of the ambiguity whic would necessarily arise from the use of such a general term as 'metamorphic,' which is applicable to any group of strata in an altered condition, while the peculiar fitness of the name was suggested by the fact that these rocks were found to constitute the bulk of the Laurentide mountains, a series of elevations lying to the north of the River St. Lawrence, and which were so called by the late Mr. Garneau, the historian, of Quebec.

The term 'gneiss' or 'gneuss' was originally employed by the early Saxon miners for the country-rock containing the Erzgebirge silver ore deposits. The rocks so named were divided into a 'red' and 'grey' variety, which although differing somewhat in their component minerals presented many features in common that caused them to be included under a uniform designation. The rocks so described are closely analogous in composition and structure to many of the rocks within the area of the present map-sheets, and to which the name 'gneiss' has been usually applied. The name was very generally adopted by geologists, and its use was primarily restricted to rocks essentially granitic in their composition and appearance, differentiated solely on account of their foliated texture; the persistency of this peculiar structure over large areas presumably furnishing proof of a difference in origin from the normal or massive type. Gradually, however, the use of the term became so extended as to include a great variety of crystalline rocks differing widely in composition and origin, but which exhibited in common a more or less decided tendency to a parallel arrangement of their component minerals.

Although modern petrographical studies have demonstrated the inapplicability of such a term for purposes of accurate description, except as an affix to denote the structural features of the rock-types examined, the name must still be employed as a convenient 'field' term, as a means of rough description and correlation where detailed microscopic examination is either impossible or considered unnecessary.

The origin of these gneissic crystalline rocks was, for a long time, more or less a matter of theory and conjecture. Previous to the promulgation of the theories regarding rock metamorphism, first held by Hutton and subsequently by Lyell, to whom we owe the first use and definition of this term, these rocks were regarded as portions of the primeval crust, which had either never been enveloped by the later sedimentaries, or from which such covering, if originally present, had been removed as a result of subsequent upheaval and denudation. Such rocks were then almost invariably referred to as the 'Fundamental gneiss or granite' and believed to be the basement or floor upon which all subsequent sedimentary formations were deposited.

Metamorphism, either regional or contact, has always been considere the most potent influence in the destruction of evidence of origin structure and composition in rocks subjected to the effect of th earth's internal heat, or that engendered by the proximity of eruptiv masses.

The various changes, however, which this term describes, were fo a long time thought to be confined entirely to sedimentary strat while masses of igneous plutonic rocks were regarded as too hard an unyielding to be at all affected by the metamorphosing agencies o even the most profound orographic movements. Foliation, thoug long held to be entirely distinct from stratification in the case o slaty and other allied rocks, was in the instance of these gneissi rocks regarded as the surviving trace of the parallel structure du to original sedimentation which had escaped obliteration. It is onl in very recent years that this impression has been overcome by detailed examination and study, both in the field and with the microscope, carried on by many individual observers in large and widel separated districts, shewing clearly that foliation and schistosity cannot be assumed to denote original stratification.

The first really exact and satisfactory account of crystalline schist resulting from the metamorphism of massive eruptives was given a the outcome of the detailed work by Lossen in the Hartz mountains who, as early as 1872,* directed attention to the deformation of diabases occurring in contact with granites, and showed the close analog existing between the results of contact and regional metamorphism as well as the production by metamorphic agencies of a foliate structure not connected in any way with stratification.

The most important contribution, however, in regard to the effects of dynamic metamorphism, appeared in 1884, from the pen of Prof Johannes Lehmann, who after several years detailed studies on the origin of crystalline schists, based on a very large number of observations made chiefly in Saxony, but also in Bavaria and Bohemia, published his celebrated memoir on this subject.† The conclusion is reached that 'gneiss' is simply a structural form of granular feldspathic rocks, and as such is capable of subdivision according to composition into varieties corresponding with the types of the ordinary massive plutonics, while the prevailing parallel structure may be, but very rarely is, original. He regards these foliated rocks as of igneous origin and not in any way related to sedimentary deposits, the characteristic structure being developed as a result of 'stretching' when the rock was in a solid state. It is further concluded that such rocks become more evenly and finely banded in proportion to the intensity of such 'stretching' action.

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*Zeitschr. Deutsch. Geol. Gesell. vol. XXIV, p. 763, Berlin, 1872.

†Untersuchungen über die Enstehung der Altkrystallinischen Schiefergesteine. Bonn, 1884.

Daubrée was also convinced that the schistose and foliated structures frequently assumed by massive rocks were not connected with original stratification, but secondarily developed as a result of pressure before the rock had wholly solidified. [‡]Naumann emphasizes this latter fact, while Reusch, from studies undertaken in the vicinity of Bergen in Norway, also comes to similar conclusions. In England, Teall, from his examination of the metamorphic area in the vicinity of the Lizard in Cornwall,[‖] reaches results closely resembling those of Lehmann; while i[illegible] United States, in the gabbro area near Baltimore, Maryland, [illegible] in the greenstone-schist area of the Menominee and Marque[illegible] in Michigan, the late Prof. Geo. H. Williams has shown the [illegible]dary development of a schistose structure in originally massive plutonic rocks.[*] In Canada, Lawson,[†] from his examination and studies of the rocks of the Lake of the Woods and Rainy Lake districts, was the first to draw attention to the fact that the various foliated crystalline rocks usually classified as Laurentian were largely plutonic rocks, which have crystallized slowly, probably under an extremely gradual diminution of temperature, from a thickly viscid, coherent or tough hydrothermal magma. The foliation was explained as a result of 'differential pressure which by causing a yielding or deformation induced a flow in the mass.'

Previous, however, to the appearance of these results, the metamorphism of sedimentary rocks occurring 'as deeply buried and sunken strata' had been so clearly described and so strongly advocated by Lyell and others that their views gained an almost immediate and world-wide credence and adoption. It is, therefore, not surprising that, in the desire to trace back as far as possible the sequence of geological events as revealed by the accumulation of stratified deposits, there should have been included at the base a complex of crystalline rocks attesting the presence not of conditions favourable to sedimentation but revealing the early unstability of the necessarily thin and weak crust, as a consequence of which it was probably peculiarly subject to upwellings of the molten mass beneath. The ultimate result being a series of immense batholithic intrusions, composed for the most part of foliated plutonic rocks which subsequent upheaval and denudation have revealed at the present surface of the earth. The outward resemblance of these foliated or gneissic

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[‡] Etudes synthétiques de géologie Expérimentelle, p. 432. Paris, 1879.
[†] Annual Report Geol. Surv. Can., vol. I., (N.S.), Part CC., 1885.
[‖] Geol. Mag., Nov., 1886.
[*] Bull. U.S. Geol. Surv., Nos. 28 and 62.

rocks to certain undoubted clastic rocks, present in later geologi
formations, which were known to have undergone extensive deforr
tion and alteration, as well as their interfoliation with truly bed
rocks seemed abundant reasons for their classification as one un
terrupted series represented by this immense accumulation of stra
fied material. Their intimate association with crystalline limestor
which were believed to have originated in much the same manner
later calcareous strata, was also cited as additional evidence of th
deposition as ordinary aqueous sediments. Subsequent work in t
county of Argenteuil, rendered almost classic by the detailed labor
of Sir William Logan, as well as in other extensive areas of Archæ
rocks in Canada, have since shown the fallacy of many of the co
clusions then reached, and both Adams and Ells are firmly convinc
that the undoubtedly clastic rocks present in the area usually co
sidered as 'typical' of the Laurentian, form but a small proporti
of the rocky complex, while they are associated with and enclos
by much greater volumes of gneissic rocks closely allied in petr
graphical characters to granite, diorite and gabbro.

In the early years of the Canadian Geological Survey the advan
of accurate and detailed information regarding these rocks w
greatly retarded for several very obvious reasons. In the first plac
by far the larger portion of the country characterized by the presen
of such rocks was a vast almost uninhabited wilderness of fores
The only access to such regions was by means of canoes, throug
obstructed and often little known routes of travel. These conditio
have in a great many instances been improved of late years by t
gradual settlement of the country and the necessary construction
roads. In the second place great difficulty was for a long tim
experienced in obtaining trained and reliable observers competent
deal with the many difficult and complex problems presented. S
William Logan, when carrying on his work in this connexion, wa
often forced to depend for information covering many essentia
details on observations by men scarcely possessed of the requisit
qualifications.

Thirdly, the extreme metamorphism and deformation to which a
such rocks had presumably been subjected on account of their ver
great antiquity, and the absence of any known methods by whic
their original minute structures and mineralogical composition coul
be deciphered, presented seemingly insuperable barriers to the com
plete and satisfactory explanation of their origin. In the fourt
place the very natural assumption that such rocks represented ex
tremely metamorphosed sediments, and the consequent application o
the ordinary methods of geological research made use of in the muc

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later and typical stratified deposits, served only to aggravate the difficulties already existing.

The adoption of the microscope for petrographical research removed the main difficulties attending a satisfactory study of these rocks, marking an era in geology, since which time the progress in exact knowledge has been rapid. In fact the accumulation of reliable information connected with this long-debated subject has already assumed such large proportions that many geologists look hopefully forward to the time when we shall probably possess an even more complete knowledge of these rocks and their manner of formation than we now do of many more recent rocks.

In 1844, when Logan decided to make an examination of the region bordering the Ottawa river, he found a mass of foliated crystalline rocks that seemed to him capable of subdivision into two conformable series, although in this, as well as many succeeding reports, he included them under the one group, which he subsequently called Lower Laurentian. The lower or older series consisted exclusively of 'syenitic gneiss showing no end to the diversity of arrangement in which the minerals and the colours will be observed, but there is a never failing constancy in respect to their parallelism. But this though never absent is sometimes obscure.' These rocks were supposed by Logan to occur in the form of a low anticlinal arch in the region extending from the Mattawa river to the vicinity of the combined mouths of the Montreal and Matabitchouan on Lake Timiskaming. The upper series is stated to crop out in the district to the south of the Mattawa and Ottawa rivers and to be characterized 'by the presence of important bands of limestone which have undergone extensive crystallization as a result of extreme metamorphism,' while the various gneissic rocks which separate the several bands of limestone 'differ in no way either in constituent quality or diversity of arrangement from the gneiss down.'

Subsequently, this lower gneiss was called the 'Ottawa Series,' while the upper group, differentiated solely in the first place on account of the presence of the limestones, was included under the name Middle Laurentian or Grenville Series. The name Upper Laurentian was given to a terrane formed chiefly of anorthosites which were afterwards shown to be of irruptive origin, and with which were classified by mistake certain gneissic and limestone bands, identical in character with those included as the Grenville Series and to which they clearly belong.

In the district, therefore, covered by the Nipissing and Timiskaming sheets, the rocks to be described would, under the old classification, have been included as Lower Laurentian, although in the area to the south of the Mattawa river precisely similar gneissic rocks, be of their inclusion of small isolated patches of crystalline lime have usually been described as of Grenville or Middle Laurentia These patches of crystalline limestone are only very occasio present, and are evidently caught up by and embedded in greater volumes of gneissic or foliated rocks here of truly ig origin, in such a way as to point to the conclusion that in limestones we may have small remaining portions of a sedime series, which, although highly altered, have not been wholly abs by the surrounding foliated material.

The term Laurentian, as applied in connexion with the map-s here under description, therefore includes only such granite diorite gneisses as are usually characteristic of this ancient com

The gneissic rocks exposed throughout this district fall natu into two great groups.

I. An acidic group:—consisting of those foliated rocks, simil composition to granites, &c., to which they correspond, differentiation being determined solely by their foliated tex which, usually pronounced, is sometimes obscure and occasio altogether absent.

II. A basic group:—These rocks occur interbanded with the acidic gneisses, and represent either basic segregated portio the granite magma or foliated basic irruptives allied to dio diabases, &c., caught up in it.

The results obtained from the detailed petrographical examina of the large number of thin sections prepared from typical specim specially selected as representing all the observed varieties occur in the region, coupled with extended observations concerning field relations, has furnished the most convincing proof that the majority of such rocks may be referred to some type of irruptive m rial. On the other hand those gneisses whose origin may be in d and which are in some cases held to be sedimentary constitute an ceedingly small proportion of the whole series. In fact, the res obtained from the examination and study are very closely analo to the conclusions arrived at by Sir Archibald Geikie regar similar old rocks exposed in the British isles, who says: 'These r are in the main various forms of eruptive material ranging f highly acidic to highly basic; they form in general a complex m belonging to successive periods of extrusion; some of their co structures are probably due to a process of segregation in still f or mobile, probably molten, material consolidating below the surfa their granulated and schistose character and their folded and crump structures point to subsequent intense crushing and deformation; their apparent alteration with limestone and other rocks which are probably of sedimentary origin is deceptive, indicating no real continuity of formation, but pointing to the intrusive character of the gneiss.'

The chief facts which together seem to prove the originally igneous character of the rocks above referred to may be stated as follows:—

1. *Composition of the gneissic rocks.*—The microscope reveals at once the identity of these in mineralogical composition with the different known varieties of granite and diorite, the constituents present, in many cases, showing little or no alteration, except that produced by local weathering, or as a result of somewhat limited dynamic metamorphism.

In order to ascertain whether the chemical composition of these gneissic rocks would bear out the conclusions derived from their study in the field and under the microscope, six analyses were made in the Laboratory of the Survey by Mr. F. G. Wait. The following are the results:—*

—	I. Granitite-gneiss.	II. Granitite-gneiss.	III. Granitite-gneiss.	IV. Granite-gneiss.	V. Cyanite-granite-gneiss.	VI. Quartz-mica-diorite-gneiss.
Silica	71·69	69·39	67·74	67·50	66·94	44·92
Alumina	14·84	17·46	16·13	18·23	17·84	18·88
Ferric oxide	....	....	1·50	....	....	2·73
Ferrous oxide	1.25	1·38	1·96	2·39	4·30	13·76
Manganous oxide	tr.	....	tr.	....	tr.	0·26
Lime	1·63	2·14	4·41	1·85	1·86	9·07
Magnesia	0·37	0·52	1·36	1·56	1·82	5·38
Potassa	7·09	2·77	1·30	4·25	3·36	0·53
Soda	3·13	5·18	4·92	3·79	1·85	2·94
Water at 100° C	0·10	0·06	0·10	0·08	0·15	0·20
" above 100° C	0·49	0·47	0·86	0·90	1·75	1·62
Totals	99·99	99·37	100·28	100·55	99·87	100·29

I. Granitite-gneiss from west shore of Taggart bay, Kipawa lake—in previous reports usually referred to as red orthoclase gneiss, granitoid gneiss or gneissoid syenite. The rock is of a deep flesh-red colour, massive and granitic in appearance, the foliation being imparted by the parallel disposition of the coloured constituents. It is highly feldspathic and only very occasional thin bands of basic material occur which are at all continuous. It contains much microcline, orthoclase plagioclase and quartz, with much smaller quantities of biotite and epidote. Sphene, sericite, chlorite, apatite, allanite and zircon are present as accidental or secondary minerals. The rock has evidently been subjected to considerable pressure. The feldspar and quartz have often undergone advanced granulation, while the surviving large individuals exhibit marked undulous extinction. Microcline, as might be expected, is abundant, as also areas of granophyre.

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*Annual Report, Geol. Surv. Can., vol. IX. (N.S.), Part R, pp. 18-20.

II. Granitite-gneiss from south shore of McLaren bay, Kipawa lake. This was selected as representing the light reddish-grey granitic gneisses so common in the district. The hand specimen shows a light-grey, rather fine-grained micaceous granitic rock, tinged with red oxide of iron, and showing only indistinct foliation; composed of orthoclase, microcline, plagioclase, quartz and biotite with a little apatite, zircon, sphene, magnetite and occasional minute individuals of secondary muscovite and epidote. The biotite shows a slight alteration to chlorite in some instances and occurs for the most part in small isolated plates, possessing a rude parallelism and rarely aggregated together. It shows only slight evidence of pressure.

III. Granitite-gneiss from west shore Lake Timiskaming at north end of Opimika narrows. A good average sample of the ordinary so-called grey-gneiss. Macroscopically this is a very distinctly foliated rock, the foliation being produced by alternating bands of light and dark-grey colours. The darker bands are composed almost wholly of the coloured constituents while the light-grey portions are made up chiefly of quartz and feldspar. The thin section shows quartz, orthoclase, plagioclase, biotite and epidote as the principal constituents. Epidote and titanite are common inclusions in the mica.

IV. Granite-gneiss from the northwest shore of Leonard inlet, Wicksteed lake. The hand specimen shows a rather coarse-grained, greyish, indistinctly foliated rock, much stained with yellowish-brown iron oxide and showing large phenocrysts of white orthoclase. The chief minerals present are orthoclase, microcline, plagioclase, quartz, biotite and muscovite. Apatite, zircon, epidote, zoisite, allanite? and pyrite were also noted in very small quantities. The rock has evidently been subjected to considerable dynamic action. The muscovite is primary, intergrown with perfectly fresh reddish-brown biotite.

V. Cyanite-granite-gneiss from the east shore of the Ottawa river, half a mile north of Snake creek. The hand specimen shows a coarse-grained granitic rock with a distinctly banded structure caused by layers rich in biotite, alternating with layers of quartz and feldspar comparatively free from that mineral. The distinctive feature of the rock is the abundance in portions of it of a light to deep-blue cyanite in large columnar individuals, some of which are half an inch across and an inch in length; garnets of a deep pink colour are also plentiful, and some individuals are as much as half an inch in diameter. Under the microscope the rock is seen to be composed of orthoclase, plagioclase, quartz, biotite, cyanite and garnet with smaller quantities of muscovite, graphite, titanite, zircon, apatite, pyrite, pyrrhotite and epidote. The rock is typically holocrystalline and granitic and shows no extreme evidence of granulation.

VI. Quartz-mica-diorite-gneiss from Ottertail creek, lower end of the second portage above the junction with the north branch. In the hand specimen this is a dark-grey, almost black, glistening, evenly foliated rock stained in places with iron oxide. It is composed of plagioclase, orthoclase, quartz, hornblende and biotite, with sphene, apatite, zircon, pyrite, magnetite and limonite as accessory minerals. The hornblende is much more abundant than the biotite. The evidence of pressure is very limited. The rock constitutes the dark basic bands so characteristic of exposures of the grey gneiss.

Time would not permit of the separate analysis of each rock-type included in the accompanying table, and therefore no attempt can be made to institute comparisons in detail with the published analyses of granites and diorites. Sufficient has been done, however, to show somewhat clearly that in general these foliated rocks bear a close analogy in chemical composition to their massive equivalents, while on the other hand they are quite different in this respect from any rock resulting from ordinary processes of sedimentation. As Dr. Adams remarks,* the points of distinction and those which mark them as of igneous origin are, high silica, combined with low alumina and high percentage of alkalies. The lime also, as is usually the case in granites, is in excess of the magnesia. It would seem, however, that the granite-gneisses, as a rule, are more basic than their massive equivalents, although presenting an equally wide range in their silica contents. The decrease in silica is accompanied by an increase in the alumina, while soda tends to exceed potash in the more basic varieties, thus marking a passage to the gabbros and diorites. The high percentage of alumina with low alkalies noticed in No. V. is due to the presence of cyanite, but otherwise the composition is essentially similar in every other respect to the ordinary granitites of this and other Archæan districts. There is, as is usual in granites, the preponderance of lime over magnesia, which though slight in this case is nevertheless in marked contrast to the sillimanite gneisses described by Adams,* where the magnesia is often nearly three times as abundant as the lime.

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*Annual Report, Geol. Surv. Can., vol. VIII. (N.S.). Part J, p. 44.

The quartz-mica-diorite (VI.) is analogous in chemical composition to the most basic phases of the gabbros and diorites. The hornblende and biotite are much more abundant than the feldspathic constituents, while quartz is only very sparingly represented.

2. *Microscopical structure.*—The various thin sections examined show unmistakeably the holocrystalline structure so characteristic of granite, diorite and gabbro, the feldspar and quartz individuals forming comparatively large areas of interlocking grains, especially in the more acidic portions or bands in the rock, with which are associated the hypidiomorphically bisilicate constituents. There is no suggestion whatever in the great majority of such rocks of the secondary enlargement which in certain arkoses and quartzites produces a somewhat similar interlocking arrangement, as the rocks have, in many instances, been subjected to but limited metamorphic action. The foliation, which is the differentiating characteristic of these rocks, is often so coarse that it is only apparent in large specimens or somewhat extended exposures of the rock. This parallelism is, therefore, often indistinguishable with the microscope, so that in the thin sections the resemblance is complete between foliated and non-foliated varieties of such essentially similar mineral aggregates.

At the present day fused magmas are regarded as more or less complex solutions, which, by reason of their high temperatures, obey the same laws in the order and method of their solidification as those which govern the crystallization of ordinary solutions of a similar heterogeneous composition. Thus, in the numerous thin sections examined, a certain general and definite order is observable in the generation or crystallization of the various component minerals, that has been rather closely adhered to in the progress of consolidation. In this manner zircon, sphene, apatite and primary epidote, which are the first to form in the slowly cooling mass, are almost invariably present in sharply outlined and well developed crystals, evidencing considerable freedom from restraint during the progress of their formation. The various iron ores which may happen to be present are of earlier generation than the coloured or bisilicate individuals, which latter are usually present with hypidiomorphic outline, although occasional individuals often show sharp and well defined crystallographic boundaries. The customary grouping together in masses or nests of such basic material produces a mutual interference of the constituent individuals which militates greatly against perfection of crystal boundaries. The various apatites, sphenes, &c., which are the first minerals to form in the cooling rock-mass, usually occur, as might be expected, either embedded in, or in close conjunction with such ferro-magnesian constituents, although the rest of the rock, while much poorer relatively in such minerals, may not be entirely free from them. The feldspar and quartz, which are the last to solidify, occur in more or less irregular areas, usually elongated in the direction of the foliation, or showing, especially in the case of the quartz, that the residual spaces existent in the rock-mass were already of this form and character.

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* Annual Report, Geol. Surv. Can., vol. VIII. (N.S.), Part J, p. 44.

3. *Macroscopical structure.*—The various dark and light-coloured bands of relatively greater or less basicity succeed one another across the strike or cut one another off, thus suggesting even to a casual observer a complicated intrusion of one portion through another, although the frequent absence of any distinctly recognizable boundary between the different folia shows clearly that such conditions obtained in the mass long before its final consolidation. Although, especially when arranged in approximately horizontal position, the alternation of such bands resembles somewhat closely the parallelism produced by the alternating sequence of stratified material of differing coarseness and composition, a closer inspection shows that there is no evidence whatever of the sorting and re-arrangement by aqueous agencies so characteristic of all sedimentary strata. The tendency to nuclear aggregation observed in the crystallization of the first-formed constituents seems to be a usual and marked feature, not only of slow cooling magmas, but of all highly saturated and complex solutions when undergoing change to the solid state. It is, therefore, quite evident, both from macroscopic and microscopic examination, that perfection of foliation is reached in these gneisses when during the process of cooling accompanied by differential movements the pressures produce a kind of flow in the still mobile mass, thus tending to the parallel disposition of the various bands or masses of differing composition. The viscosity of the whole was such as to prevent the too free transmission of the material of contiguous bands or portions, thus furnishing the approximately sharp lines of division so frequently observed.

4. *Junction with overlying rocks.*—The immediate contact, or line of junction, with originally overlying clastic rocks, reveals undoubted evidence of the irruptive character of the gneisses. Numerous and detailed observations have been made of the line of demarcation between these Laurentian gneisses and Huronian slates and quartz-

ites, which latter are of undoubted clastic origin. The behaviour o the gneissic rocks under these circumstances is precisely similar i every respect to that which obtains in the case of granite, intrusiv through neighbouring bedded strata. Detailed descriptions hav already appeared regarding the various contact phenomena witnesse along the line of junction between the Laurentian and Huronian embracing not only this region, but also the district to the southwes included within the area of the Sudbury and French River map-sheet (Nos. [illegible] and [illegible] Ontario). The facts there noted, and since born out by [illegible] observations, show distinctly that the gneisse are intr [illegible] Huronian, and are, therefore, in their present form younger than the clastics which they invade. Although i places, a [illegible] composition exists which might be mistaken for a alternati [illegible] stratified material, the relations thus observe find thei [illegible] presence, at these places, of a zon of varyi [illegible] by a commingling of the sedimentar material [illegible] rocks, as a result of actual fusion, or b the presence of a [illegible] more or less parallel dikes piercing thes clastics.

The foliation presented by these rocks is of two distinct kind although there is almost every possible graduation between these tw extremes. It may consist of the parallel arrangement of certain o the constituent minerals, usually the bisilicates, but sometimes als the porphyritic feldspars, or it may be due to an alteration of lighte or darker bands, showing a varying chemical and mineralogical composition. Intermediate phases of such structures are produced by th development, in more or less approximately parallel position of nucle or nests, of the ferro-magnesian constituents, whose gradual coalesc ence into ever-lengthening bands produces ultimately that perfectio of foliation actually found.

The foliation just described is the one characteristic of the mor massive and granitoid varieties, included under the first or acidi group, and is evidently the result of the application of pressure to magma of somewhat homogeneous composition. On the other han the second variety of foliation is produced by alternating sequence of rocks belonging to both acidic and basic groups, and has been in parted to the rock-mass as a result of differentiation in a slowly coo ing magma of heterogeneous composition, aided by a flowing movement in a more or less constant direction.

The results obtained by the microscopic examination indicate, in th most positive manner, that the banded structure so universally observ

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*American Geologist, vol. VI., pp. 19-32 (July, 1890), also Bull. Geol. So Am., vol. IV., pp. 313-332 able in such rocks was imparted to the whole mass while still in a molten, or, at most, only partially consolidated condition. One of the most significant facts noticed in this connexion is that many of the most markedly foliated gneisses show little or no trace of having been subjected to any great degree of deformation; nor is there any reason whatever to suppose that the rocks so examined have undergone such recrystallization as to mark the evidence of such action, if any previously occurred. In many instances it is equally certain that subsequent dynamic action has, after the complete solidification of the magma, somewhat modified and accentuated such foliation, but even in these cases there is every reason to believe that pronounced parallelism previously existed as a primary structure of such rock-masses before the application of pressure.

The somewhat uniform direction in strike of this banded structure over the larger portion of the area covered by the accompanying map-sheets, and its marked correspondence in direction with the line of outcrop of the neighbouring stratified Huronian rocks, seems to point to the conclusion that the resistance offered during the irruption of these gneisses by such hard strata has been the main determining feature of the direction of foliation. During the progress of this igneous invasion the forces of upheaval acted along certain definite lines or centres, thus producing irregular ovoid forms, often of great area, the inner portions of which are now occupied by comparatively flat-lying gneisses, or, in occasional instances, by more massive or granitoid varieties, surrounded by an outer border or zone where the foliation becomes much more pronounced. In certain instances, where the dome-like structures thus produced have been denuded and are of limited extent, a great diversity exists in both the direction and angle of dip of the foliation within a comparatively small area, but where, as is usual throughout this district, these ovoid areas are of great size, the direction of foliation shows a corresponding increase in uniformity.

Intimately associated with these gneisses and granites are certain portions, often of themselves constituting considerable and therefore important rock-masses, which, on account of certain peculiarities of composition, as well as from their structural relations with the surrounding rocks, have been commonly referred to as 'pegmatite,' and which by reason of their usually coarse crystallization have been sometimes called 'giant granite.' Haüy first applied the name pegmatite to the intimate admixture of orthoclase and quartz, also known as graphic granite. Later, Naumann extended its use to include all the coarse varieties of muscovite-granite, vein-like in appearance and frequently containing tourmaline. Subsequent writers, as detailed investigations into its composition and origin proceeded, have still further widened its use, until, at the present day, the employment of the term in connexion with that of the parent plutonic mass with which it is associated is necessary before any definite idea can be formed of its precise mineralogical composition. In petrography the terms micro- and macro-pegmatite have always been used in a structural sense only to denote those intergrowths of quartz and feldspar, or of two differing species of feldspar which are sometimes characteristic of occurrences in rocks of these minerals. Thus the various plutonic masses of syenite, diorite, gabbro and diabase may each have their individual pegmatitic equivalents, representing the final product of their solidification, although the abundance of such aggregates in connexion with these rocks is much less than in the case of granites. This comparative infrequency is perhaps most adequately explained by the relatively much greater basicity of such rocks, their more rapid rate of cooling, as well as the comparative scarcity, throughout the greater portion of the mass, of any such abundant and intimate association of fused rock and heated water as would tend to their formation; for, while it has been clearly shown by M. Fouqué and Michel-Lévy, that diabase and similar basic rocks may be artificially reproduced in the laboratory from a state of simple dry fusion, it is extremely doubtful whether any extensive intrusive process produced by natural causes is ever unaccompanied by a greater or less abundance of superheated water as an integral portion of the fused mass.

In the region under description the granite pegmatites are, as usual, by far the most abundant, but there are occasional dikes in which the occurrence of oligoclase and hornblende as the main constituents would determine their classification with the diorites.

In composition these pegmatite masses consist essentially of quartz and the more acid feldspars, chiefly orthoclase, oligoclase, albite and microcline, while muscovite is the prevalent ferro-magnesian constituent, when any is present, and hornblende and biotite are much less characteristic. The parallel intergrowth of orthoclase and albite, to which the name perthite has been applied, is an abundant and sometimes prevailing feldspathic constituent of the pegmatite dikes, especially in the vicinity of Mattawa. The composition is, therefore, somewhat variable, but these dikes or vein-like masses are essentially similar, though somewhat more acid than the normal plutonic rock of which they represent the most highly differentiated or final product of consolidation. Thus, in those areas where the gneissic rocks contain a superabundance of basic material, with plagioclase as the predominating feldspathic constituent, the associated pegmatite usually shows a corresponding increase in relative basicity, oligoclase seemingly being the most abundant feldspar. In areas of hornblende-granite the associated pegmatites contain hornblende as the coloured constituent. The preponderance of the granitite gneisses, or biotite-granite-gneisses in this region, is represented also by a far greater relative abundance of the pegmatitic phases of such rocks, while the far greater prevalence of muscovite, which usually occurs altogether replacing the biotite of the normal parent plutonic, evidences the presence of the greater abundance of heated water tending to the more or less complete elimination of the iron present in this bisilicate and the consequent conversion of the mineral into muscovite.

The pegmatites have not yet been examined sufficiently in detail to call for any lengthy mention of their accessory or accidental minerals. In other districts these masses are especially noted as favouring the development of many of the more unusual and rare minerals. In a pegmatite dike cutting gneissic rocks about a mile northwest of Eau Claire station opaque crystals of beryl occur. The crystals secured are usually of a pale yellowish, but sometimes of a bluish, colour and some of them would exceed five pounds in weight. An examination by Mr. R. A. A. Johnston* of some specimens collected from the same locality by Mr. W. C. Willimott showed likewise the presence of the comparatively rare minerals, xenotime and polycrase. Cyanite, although an abundant constituent of the granitite-gneisses in the vicinity of Les Erables rapids and the mouth of Snake creek on the Ottawa, exhibits its most perfect crystallographic development in the coarser and more acid bands which are evidently of pegmatitic origin. Fluorite is also an abundant and frequent constituent in the pegmatites cutting the gneisses near the Ottawa in the township of Cameron, about five miles east of Mattawa. In the necessarily more or less hurried examination of the large number of these pegmatite masses there was found, however, a conspicuous monotony in composition.

The intrusive character of pegmatite is now so generally recognized that the various theories, formerly extant, regarding it as in some manner due to aqueous infiltration and deposition, may be considered as disproved, while the view that pegmatite constitutes the most acid phase or final differentiation product attending the progressive crystallization of certain intrusive plutonic rocks has been very clearly and ably set forth by Lehmann,[*] Brögger[†], Williams[‡] and others, and all have given expression to the opinion that water played a most important role in their formation. Probably the most satisfactory explanation which has yet appeared is that lately issued as the joint production of Messrs. W. O. Crosby and M. L. Fuller o Boston.[§] These authors recognize "that the most satisfactory explanation of this blending of the pegmatite with quartz veins on the one hand, as with the normal granite on the other, is to be found in a corresponding blending of aqueo-igneous fusion with igneo-aqueous solution; and this dynamic gradation, it appears to us, can only result from the gradual hydration of the residual magma during the slow centripetal solidification of a body of magma and a consequent elimination of water."

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*Annual Report, Geol. Surv. Can., vol IX, (N.S.), p. 13 R; also Am. Jour. Sc., March, 1899, p. 243; also Summary Report Geol. Surv. Can., 1898, p. 167.

In this paper the authors further state that pegmatite should be regarded, 'not as a distinct species or family of rocks, but rather as a possible textural phase of all, or nearly all, the plutonic rocks; and we may, in general, say of any plutonic rock that it may be crypto-crystalline, micro-crystalline, macro-crystalline or pegmatitic.'

The consensus, therefore, of recent opinion, seems to favour a intrusive origin for pegmatite, the progressive increase in hydration of the residual magma being explanatory by a corresponding increase in acidity of its later crystallization.

The stages represented completely by the occurrences in this region show a perfect and practically uninterrupted continuity during the consolidation of these rocks, from an original condition of hydro-igneous fusion characteristic of the magma from which the comparatively fine and even-grained parent plutonic is generally believed t have resulted, to conditions of aqueous solution which must have obtained in the viscous mass from which the latest quartzose segregations have solidified. Such views are in harmony with the known occurrences of most of the quartzose masses and veins so frequently present in these Archæan rocks, and which have evidently originated by a process closely allied to that described above, in consequence o the deposition from supersaturated solutions of highly siliceous material, and are substantially contemporaneous with the parent plutonic mass with which they are so intimately associated.

The age relations of the component minerals are practically th same as that in the more usual types of plutonic rocks. Thus biotite, muscovite, and the more basic feldspars crystallized out in regular succession in the order mentioned, showing a gradual decrease in perfection of idiomorphic development. The more acid feldspars, and finally the quartz, follow, the latter especially showing little or no evidence of crystal boundaries occupying the interspaces left by the earlier development of the more basic constituents. When drusy cavities exist in these pegmatites, as well as in the quartzose and more vein-like occurrences, the silica sometimes exhibits a decided tendency towards crystalline development. The presence of such unfilled spaces, especially in the immediate vicinity of such perfect crystal forms, seems to furnish evidence of the insufficiency of the siliceous material in solution to fill the spaces, permitting a more or less unrestricted development of the remaining quartz. They likewise point, not only to the extreme acidity of the last remaining portion of the partially solidified magma, but also to its approximately homogeneous composition.

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[*] Ueber die Entsehung der altkrystallinischen Schiefergesteine Augit un et seq

[†] Dis Mineralien der Syenitpegmatitgänge der südnorwegischen Augit un Nephelinsyenit I, Theil pp. 215-225. Translated by N. N. Evans, Can. Re Sc., vol. VI., Nos. 2 and 3, pp. 33-40 and 61-71.

[‡] Origin of the Maryland Pegmatites, XVth Ann. Rep. U.S. Geol. Survey, p 675-686.

[§] Technology Quarterly, vol. IX., No. 4, December, 1896, pp. 326-356.

The exact depth below the earth's surface necessary for the formation of these pegmatites and their parent masses of normal plutonic rocks, as well as the amount of pressure during the progress of their crystallization, is a mere matter of speculation. Of recent years a perfect gradation has been traced from the typical holocrystalline structure characteristic of granite, gabbro and other plutonic rocks, in a vertical distance of a few hundred feet upward, into a porphyritic phase at the surface; while the pressure required, as pointed out by Brögger, would be obtained by the presence of superimposed material, great enough to prevent the water separated out by the progressive crystallization from escaping freely to the surface.

The most distinctive feature concerning the development of these masses is their extremely coarse crystalline texture, which is in very striking contrast to the normal or usual crystallization of the parent plutonic rock with which they are associated. The resemblance in many of the quartzose varieties to quartz veins, originally regarded as due solely to lateral secretion and aqueous deposition, is so very marked that it is difficult to see how any hard and fast line can be drawn between these separate occurrences. Usually in these cases there is a somewhat indistinct zone-like arrangement of the material, the masses presenting a finer grained feldspathic portion in the vicinity of the walls, and showing a continuous transition towards the interior, which is often occupied by comparatively large allotriomorphic masses of almost pure quartz. Usually there is a perfect gradation into the parent plutonic when this is the enclosing rock-mass, while an undoubted passage can very frequently be traced into areas of pure quartz, and occasionally into rather typical or ordinary quartz veins.

In the region embraced by this report there are two somewhat distinct phases of such rocks. The most frequent and abundant is perhaps represented by the acidic facies of the gneisses constituting the coarser and more feldspathic and quartzose bands. These present all the distinguishing characteristics of pegmatite, although occurring in perfect conformity with the prevailing foliation. In composition they show the usual great preponderance of feldspar and quartz, with only very occasional flakes of biotite, which in many cases has undergone notable bleaching owing to the elimination of a considerable proportion of the iron originally present. Such biotite is much paler in colour, with less marked pleochroism, and shows the brilliant chromatic polarization colours, though perhaps in a less degree, so characteristic of the lighter coloured mica. The most frequent and abundant coloured constituent, however, is muscovite, which in some cases, at least, is an original constituent, although a great deal has undoubtedly resulted from the alteration of the biotite. These pegmatitic bands very evidently represent the residual and more acid portions of the magma which have crystallized *in situ,* and may be referred to as examples of what has been called 'sedentary pegmatite.' They usually show a perfect, though somewhat rapid, transition into the more basic bands immediately adjoining, and are, therefore, to be regarded as more strictly contemporaneous than those constituting the second mode of occurrence. These are masses or apophyses of residual and consequently more fully hydrated and acid portions of the magma, which have invaded and filled various cracks and fissures occurring in the gneissic *massif* or in the neighbouring clastic rocks. They are usually present in more or less marked conformity with the foliation of the gneissic rocks, but very often fill rifts which intersect this at considerable angles. Although in the detail of their structural relations many of these occurrences are obviously newer than the associated gneisses, the general examination of the masses throughout the whole area seems to show that they must be regarded as substantially of the same age. The process of crystallization was evidently practically continuous from the first development of the earlier constituents in the still molten and viscous magma to the filling in of the most minute cracks and fissures by the remaining quartz, marking the final step in the complete solidification of the whole mass. Intimately associated genetically with these pegmatites are certain veins and even veinlets of quartz, sometimes containing feldspar, which penetrate and anastamose through the prevailing gneisses as well as through the clastic rocks of this district. These are especially numerous and well developed along the lines of contact between the various plutonic masses and the Huronian clastics, and it seems probable that by far the greater number of these infiltrations of secondary quartz are due to the extravasation and differentiation of the numerous large masses of these deep-seated irruptives exposed so frequently throughout this area.

In those portions of the area coloured as Laurentian, where the rocks present have solidified from a magma more or less homogeneous in composition, the foliation generally present is seen to consist usually of a parallel alignment of the bisilicate individuals, or, at most, of small nests or nuclei composed of an aggregate of scales or fragments of such constituents. Such rocks are in many instances of somewhat later generation than the more evenly foliated gneisses, and frequently contain considerable masses or fragments of these that have been caught up during the irruption of the former. At other times such homogeneous masses are simply more granitoid portions of the prevailing gneiss, into which they merge both across and along the strike of the foliation, so that both are strictly contemporaneous with one another. The area of granite to the northeast of Lake Timagami, especially in the vicinity of Carrying and Annima-Nipissing lakes, has a marked foliated texture, due to the more or less parallel disposition of aggregates of greenish chlorite scales resulting from the decomposition of the biotite originally present. This foliation is more pronounced near the junction with the Huronian slates on these lakes, gradually fading on passing inwards towards the centre of the mass. On Lake Timiskaming, as well as near the south end of Cross lake, the Laurentian in contact with the breccia-conglomerate of the Huronian is a massive granite, very poor in bisilicates, but which gradually merges southward into very typical and evenly foliated gneiss,showing the usual alternating sequence of acidic and basic material. In the vicinity of Lake Nasbonsing the rock, wherever exposed, is a massive flesh-coloured gneiss very rich in orthoclase and microcline, while the foliation is produced by the parallel disposition of a rather sparing quantity of hornblende and garnet. This rock passes by insensible gradations into the more evenly foliated varieties exposed on the north shore of the lake between Nasbonsing and Bonfield stations, although in the vicinity of Bonfield station itself the rock is so massive that little or no structural details could be traced.

Where greater heterogeneity in the original composition of the magma has prevailed the foliation present shows a corresponding increase in the perfection of its development, consisting as it does of alternating bands of lighter and darker coloured material, representing numerous varietal forms of rock-types which may be referred

respectively to either the acidic or basic groups already mention
This foliation it is which generally characterizes the rocks exposed
the area covered by the accompanying map-sheets.

The component bands are of variable thickness. Occasionally the
is an exceedingly sharp line of demarcation between the alternati
folia, but as a general rule there is a complete though somewh
rapid transition from one to the other. Even in their subordina
arrangement the constituent bands show the same marked tender
towards parallel arrangement, and a thick bed of prevailing fel
pathic composition will, in cross section, present short dashes or sm
patches of biotite or hornblende all drawn out in one direction; whi
on the other hand, the more basic portions show a similar defin
arrangement of long lenticules of lighter coloured material, in whi
a relatively greater amount of feldspar or quartz is present. T
continuity of these folia, both large and small, is broken at freque
intervals, sometimes abruptly, but usually by a gradual thinning
in either direction. Frequently, before such interruption takes pla
bands of essentially similar composition may be formed immediat
above or below, which in turn pinch out in both directions to be ag
replaced by others. This irregularity in horizontal arrangement
equally true of their downward or vertical extension, so that
whole section of even a small area of any such rock-exposures p
sents an exceedingly complicated arrangement of lighter and dar
material of greatly varying acidity and basicity. It is quite evid
from their macroscopic arrangement that their formation was atte
ed with an extremely gradual diminution of temperature, for
frequent absence of sharp lines of demarcation between these ba
of widely different composition seems to point to the re-absorpti
by the later and more acid portions of the magma of the first form
or faster cooling basic portions, perhaps many times repeated bef
the final consolidation of the whole mass.

In many places the dark bands evidence the action of extens
crushing and crumpling, showing that great movements have tak
place in the whole series. These movements were doubtless appro
mately synchronous, and closely connected with the invasion a
cooling of the more acid portions of the magma. The most curi
and complicated structures are thus often produced, this complex
being enhanced by the frequent dislocation, accompanied someti
by considerable separation and displacement, of those portions wh
evidently existed originally in unbroken continuity. Such intric
structures are, however, usually extremely local in their developme
the gneiss elsewhere in the vicinity often showing little or no sign
extreme disturbance. Although, as a general rule, the direction

this foliation shows a marked uniformity over large areas, there is a considerable diversity in arrangement in this regard, as indicated on the accompanying maps.

A careful correlation of the many observations made shows clearly that these gneissic rocks occur for the most part in the form of large rudely oval or concentric masses whose longer axes have in general a direction according with the prevailing strike of the foliation. Frequently such large ovoid masses present quaquaversal dips, which in cross-section simulate the ordinary anticlinal arch. About a mile east of Mattawa station the Canadian Pacific railway cuts through a small dome of these gneissic rocks, composed of beautifully sharp alternating feldspathic, micaceous and quartzose bands, showing a remarkably perfect example of very pronounced differentiation. The section as presented on either side of the railway track presents a marked resemblance to a low anticlinal dome. Plate III. The truly igneous character of the composing rocks, however, would not permit of such an interpretation. In size these ovoid masses vary greatly, some of the curvings belonging to ellipsoids many miles in diameter, while others are a mile or less in diameter.

As a rule the folia or *laminæ* have a prevailing dip to the southeast or south, which is singularly uniform over large areas. This inclination is generally rather steep, usually considerably over 45°, while, frequently, as in many places along the shores of Lake Timiskaming, the foliation is almost, if not quite, vertical. On Seven League lake and southwards to Mattawa, as well as westwards to Tomiko lake, the bands frequently succeed one another in almost horizontal succession, the dip, if any, being generally southwards at a low angle. Even in this area, however, there are frequent exceptions to this rule, and the rocks often show a rapid change in this prevailing horizontality as though the bands had been subjected to frequent disturbances and dislocation during the progress of their formation. Thus in the vicinity of North Bay and the northern portion of Lake Nipissing the gneisses often approach a vertical attitude, while on the southern shores in the vicinity of French river similar rocks are nearly horizontal.

PETROGRAPHY OF THE LAURENTIAN.

The petrographical work done in connexion with the present report was carried out with the co-operation of Mr. W. F. Ferrier, Lithologist to the Geological Survey, to whom credit must be given for many of the results obtained.

The writer and Mr. Ferrier worked in conjunction on the problems involved and with so free an interchange of ideas throughout that

no attempt will be here made to separate the examinations, more t
to mention that many of the more critical specimens were made
subject of special study by Mr. Ferrier.

The main object of these detailed studies has been not only to
tain more accurate information with regard to the composition
minute structures of the various rocks, but also to gain an increa
knowledge of their origin and the relationship existing between
alternating bands of relatively greater or less basicity.

Incidentally a table has been prepared, showing a classification
these old crystalline rocks, displaying not only their composition,
also their close affiliation with one another. This table may rec
mend itself to petrographers, as it has done to the authors, and i
hoped may be found of material use in future work undertaken
areas of similar Archæan gneissic rocks.

Much microscopical work has been accomplished in connex
with a series of specimens taken as illustrative of the various cont
phenomena exhibited along the line of junction between the Laur
tian and Huronian. This has enabled a more accurate interpretat
and description of the various facts having reference to the relat
ages of these two series of rocks. Field-work, no matter how care
or extended, in areas characterized by the presence of Archæan stra
must of necessity lose much of its value if unaccompanied by c
current petrographical studies. In the present instance the resu
have been adduced not only from a critical and extensive exam
ation of the numerous rock-exposures in the field, but also by a ca
ful correlation of the facts thus ascertained with those acquired
the petrographical laboratory.

Classification.

Any system of classification applied to such a series of folia
rocks must, necessarily, in some respects be unsatisfactory; bu
grouping together according to their mineralogical composition see
on the whole to be the best that can be adopted in the present state
our knowledge.

As already stated, however, there can be no doubt that all of
petrographical types represented in the gneisses from this region
allied in their chemical composition and mineral constituents to s
plutonic igneous rocks as granite syenite, diorite gabbro, etc., but
might be expected, there is a passage from one rock-type to anoth
sometimes gradual, sometimes very abrupt, according to the abu
ance or scarcity of certain minerals.

It must be borne in mind that the classification here adopted is
arbitrary one, based on the mineralogical composition of the roc

and to a certain extent on variations in their structure, the object being, excluding theoretical considerations, to establish certain well defined petrographical types that have been found to be constant in the area examined, and to which specimens from other districts may be referred.

No attempt has been made to examine minutely all the specimens collected, but good examples of the more prevalent types have been selected and described in detail.

As previously stated the gneisses of the region may be placed in two great divisions, the acidic characterized by orthoclase as the predominant feldspar, and the basic by the predominance of plagioclase. Biotite is by far the most abundant ferro-magnesian constituent of the first division, and hornblende of the second.

The first division may be subdivided into seven groups, dependent on the presence of one or other of the coloured constituents. Arranged, approximately, according to frequency of occurrence in the collection, they are as follows:—

1. Gneisses characterized by the presence of biotite and primary epidote.
2. Gneisses in which biotite alone is present.
3. Gneisses in which both biotite and muscovite occur.
4. Gneisses in which hornblende accompanies the micas.
5. Gneisses in which cyanite, graphite, garnet, etc., accompany the biotite.
6. Gneisses in which hornblende alone is present.
7. Gneisses in which muscovite alone is present.

The relationship of these rocks to their analogous massive types may be seen by reference to the accompanying table.

Of the second division, the basic or hornblende gneisses, two varieties may sometimes be distinguished, first, those which represent seggregated bands of the more basic material of the original granitic magma, and secondly, those which are undoubted basic eruptives folded-in with the more acidic gneisses.

It is not always possible to make this distinction, but examples of each of these two varieties have been observed.

Classified according to their mineralogical composition they naturally must be placed close to each other.

Amongst the first, whilst certain names have been applied to individual specimens, it is manifest that no hard and fast lines can be drawn in the field. For instance, a band of which one portion would have the mineralogical composition and characters of a quartz-mica-diorite may pass insensibly into material having all the characters of a hornblende-granitite, according as the plagioclase diminished and monoclinic feldspar increased in quantity.

One remarkable fact in connexion with these basic bands is the great scarcity in them of augite, none of the hornblende containing cores of that mineral, or affording any direct evidence of having originated from it.

In the Laurentian area lying to the north of the Island of Montreal, recently described by Dr. Adams,* on the contrary, the basic bands in the gneiss appear to consist largely of pyroxene rocks.

I.—*The Granite-gneisses.*

In colour these rocks range from a light-grey to a decided red. The red rocks represent what has usually been called by the older writers on the Archæan, the 'red orthoclase gneiss,' but we find in the field every gradation from the grey to the red gneiss, the one passing imperceptibly into the other in many localities, and the microscopical examination has failed to detect any essential point of difference between these two varieties.

The red gneisses contain a large quantity of hydrous iron-oxides distributed through them, to which the coloration is due, and they also appear to have a larger proportion of microcline than the grey ones. Plagioclase was not observed to exist in any greater quantity in the grey varieties than in the red ones.

Many of the more altered mica-gneisses have assumed a dark-green colour, owing to the chloritization of the biotite, but microscopic examination shows that they may be included in the same class as the typical unaltered ones.

These chloritized mica-gneisses have been frequently, though erroneously, spoken of as hornblende-gneisses by the earlier geological observers in this region, who were misled by their colour and had not the advantages afforded by microscopical examination of the rocks. A remarkable feature of these gneisses is their comparative freedom from iron ores.

When pyrite occurs it is almost always associated with large clove-brown sphenes.

In the case of the micaceous gneisses, *i.e.*, those in which biotite alone, or biotite and muscovite together, constitute the predominating ferro-magnesian constituents, hornblende was observed in only two instances, and then in minute quantities.

The almost total absence of augite from these rocks is to be particularly noted. Even in the basic hornblende gneisses of the region this mineral is very rarely, if ever, to be found.

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*Annual Report, Geol. Surv. Can., vol. VIII. (N.S.), Part J., 1896.

A. *Biotite-muscovite gneisses—(Granite-gneiss).* The rocks grouped together under this heading are, like the other gneisses, holocrystalline and granitic in their structure. Both biotite and muscovite are present as the chief, and in fact almost the only, coloured constituents. These two micas occur intergrown with each other in aggregates of broad fresh plates. The specimens representing this rock-type are, apparently, not very numerous in the collection. Those examined are remarkably free from epidote, iron ore and titanite.

Orthoclase and microcline are the predominating feldspars, and granophyric intergrowth of the quartz and feldspar is a common feature.

B. *Muscovite-granite-gneiss—(Pegmatite in part).* The rocks thus designated and classified are of comparatively rare occurrence as strictly integral portions of the gneissic complex, and where present constitute the latest secretions from the original magma.

In reality they represent interfoliated bands of pegmatite, although of much finer texture than the rock to which that name is usually applied. In colour they are white, light-grey, or pale-pink, presenting glistening or pearly cleavage planes. Under the microscope they present the usual interlocking holocrystalline aggregate of quartz, orthoclase, plagioclase (oligoclase) and microcline, with a smaller amount of sericite (hydrous muscovite) arranged in long drawnout scales and plates which traverse the rock in curving and approximately parallel bands. A small quantity of epidote and zoisite in crystals and grains, some of which may be primary, is associated with small scales of sericite, the latter, at least, being one of the products of the incipient decomposition of the feldspathic constituents. Occasional small flakes or scales of a much bleached biotite occur, some of which form a parallel intergrowth with the muscovite. The specimens examined have undergone extensive deformation, as a result of pressure subsequent to the cooling of the rock, and both feldspar and quartz have suffered a somewhat marked granulation, while the surviving individuals of both these minerals exhibit wavy extinction rather perfectly. Some of the muscovite is doubtless of primary formation, although some has evidently resulted from the shearing of the feldspar.

C. *Biotite-granite-gneisses—(Granitite-gneisses).* Var. (*a*) Biotite-epidote-gneiss.—The combination of biotite and epidote as the principal coloured constituents forms a well defined rock-type which has been found to be remarkably constant over large and widely separated areas, and is the one which is represented by the largest number of specimens.

These rocks are undoubtedly of irruptive origin, and are, in fact, foliated granitites, thoroughly holocrystalline and granitoid, varying from coarsely to finely crystalline; the constituent minerals being, as a rule, equally developed on all sides.

Var. (*b*) Biotite-gneiss. These are foliated, holocrystalline, granitic rocks in which biotite alone, or accompanied by very trifling quantities of secondary epidote, is the ferro-magnesian constituent.

In the specimens of this type of rock which have been examined the mineral does not occur, as a general rule, in aggregates of broad plates, but in isolated independent ones which have an approximately parallel arrangement determining the foliation of the mass.

Var. (*c*) Biotite-cyanite-gneiss. This gneiss, though somewhat remarkable in its mineral composition, in that it contains cyanite, garnet and graphite in addition to the biotite which chiefly characterizes it, does not present any evidence whatever, either in its microscopical structure or its field relations, of any other than an irruptive origin.

It is a perfectly fresh, holocrystalline, foliated granitic rock, and possesses in its structure no features which would at all suggest recrystallization. It seems to be a peculiar local phase of the prevalent biotite-gneisses of the region, differing in no way from them as regards origin.

A somewhat similar gneiss from near Wanapitei station in the Sudbury district has recently been petrographically described by Dr. T. L. Walker,* who, however, says little regarding its microscopical character and field relations, beyond assigning it to the Laurentian and stating that he regards it as a 'true gneiss' and not a crushed granite.

Var. (*d*) Hornblende-granitite-gneiss.—The rock thus classified differs but little in microscopical character from the ordinary micaceous form of the granitites, although usually darker in colour and more basic in appearance. It shows a transition on the one hand into granitite containing biotite alone as the coloured constituent, which is the prevailing type of these gneissic rocks, and on the other into hornblende-granite-gneiss, which latter facies is of rather rare occurrence throughout the district. In all previous descriptions the hornblende-granite-gneiss has been reported as the variety most commonly present in the Laurentian, the mistake having undoubtedly arisen from the frequent chloritization of the biotite originally present in

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*Geological and Petographical Studies of the Sudbury Nickel district. Quart. Journ. Geol. Soc., vol. LIII., p. 42, 1897.

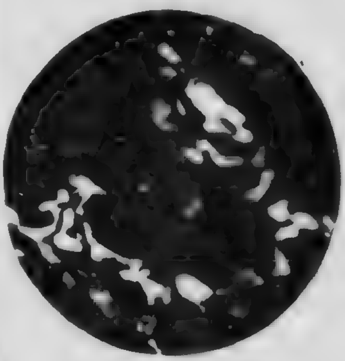

Fig. 1

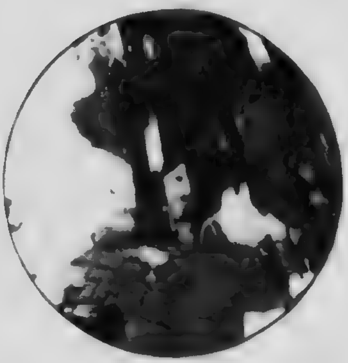

Fig. 2

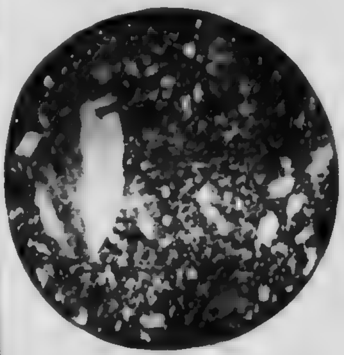

Fig. 3

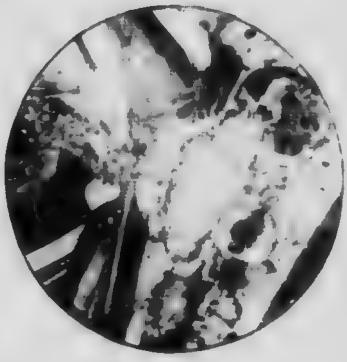

Fig. 4

Fig. 1. Micropoikilitic structure in hornblende of diorite. West Arm, Lake Nipissing. ×65.

Fig. 2. Primary epidote in biotite of quartz-mica-diorite-gneiss. Gordon creek, four miles from [illegible] Sault, Lake Timiskaming. ×65.

Fig. 3. Character and position of included fragments in typical greywacke. Little river, Lake [illegible]. ×65.

Fig. 4. Rim of chlorite, surrounding augite of diabase. Fanny Lake. ×52.

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the prevalent granitite, the individuals showing the more advanced stages of decomposition bearing a marked macroscopical resemblance to those of the ordinary green trichroic hornblende usually noticed in these Archæan rocks. The rock presents the usual reddish or greyish colours, and, where highly differentiated, exhibits the usual interfoliation of lighter and darker coloured bands, although the lenticular areas or patches of the former are relatively less abundant and of smaller extent than those of darker hue. The structure of the rock is holocrystalline; it is composed of quartz, orthoclase, plagioclase, microcline, biotite and hornblende as the chief or essential constituents, together with a much smaller quantity of ilmenite (in part altered to leucoxene), magnetite, sphene, epidote, apatite and zircon, as accessory or accidental constituents; while chlorite, calcite, and sericite usually occur in more or less abundance as secondary products of decomposition. Hornblende is the most abundant ferromagnesian mineral in the more basic portions, while biotite predominates in the lighter coloured patches. The rock presents no unusual features as regards crush phenomena, the component individuals of feldspar and quartz usually showing little evidence of having been subjected to any very considerable pressure subsequent to consolidation.

D. *Hornblende-granite-gneisses.*—This facies of rock seems to be of rather limited and rare occurrence in the district under description, and the specimens from which the thin sections were prepared for purposes of study were obtained in close proximity to masses of basic pyroxenic or hornblendic material. Their composition and association has suggested that the rock may represent a commingling or transference of material, through fusion, of the substance of both rocks. The rocks thus classified resemble very closely the hornblende-granites with which they are intimately related. The most common of the essential constituents are quartz, orthoclase, microcline, plagioclase and hornblende, with sphene, apatite, iron ore, zircon, epidote and garnet as accessory minerals.

The colour varies greatly, depending largely on the composition, the more basic portions being dark-greenish to almost black, while the acidic bands are greyish or reddish.

Certain of the more massive and homogeneous varieties of these rocks have a distinct flesh-red colour, with a greenish tinge given by the prevalence of the hornblende.

In common with the rest of the gneisses these rocks have been subjected to pressure of varying intensity, resulting in the granulation of the quartz and feldspar.

II.—*Syenite Gneisses.*

These do not appear to have many representatives amongst the rocks of the region. Those observed correspond to the mica-syenites of the massive plutonic igneous rocks and may be termed:—

Mica-syenite-gneiss.—This is a holocrystalline foliated rock characterized by the almost total absence of quartz, and the presence of biotite as the principal ferro-magnesian constituent.

Orthoclase is the prevailing feldspar in the typical examples, but in the one specimen which was examined a plagioclase (oligoclase or albite) was found to constitute nearly 50 per cent of the feldspar present in the section.

These rocks are undoubtedly the foliated equivalents of the massive mica-syenites, which, as is well known, frequently contain a considerable quantity of albite in addition to the orthoclase and biotite.

III.—*Diorite Gneisses.*

Var. (*a*) *Quartz-mica-diorite-gneiss.*—Macroscopically this rock is of a dark-grey almost black colour, very evenly foliated, and presenting brightly glistening cleavage surfaces. Sometimes very narrow interfoliated bands are more acid in composition, and have a reddish or greyish tinge owing to the presence of a considerable quantit of feldspar and quartz, more or less stained by hydrous oxide of iron

Both in the field and under the microscope these are seen to merg gradually into the more basic varieties of the granite-gneisses, fror which they differ chiefly in that the orthoclase is replaced by plagic clase as the predominating feldspathic constituent, while hornblend instead of biotite, is present as the principal ferro-magnesian minera occurring in considerable quantity even in the most basic phases c the rock, while both these minerals are always abundant enough characterize it. The constituent minerals are essentially identic with those noticed as present in the more basic types of granite-gnei differing only in the order of their relative abundance and importanc The coloured constituents, such as hornblende, biotite and spher make up the greater part of the rock, which is relatively much poor in feldspar and quartz, the most important and abundant miner in the granite-gneisses. The essential constituents usually notic are plagioclase, orthoclase, quartz, hornblende and biotite. Microcli is very often present in subordinate amount. Primary epidote very sharp idiomorphic crystals, embedded chiefly in unaltered bioti and sometimes penetrated by wedge-like crystals of sphene or titani was frequently noticed. Of the accessory minerals, sphene, apat and zircon are almost invariably present, while pyrite, magnet limonite, epidote and allanite likewise sometimes occur. These b bands are undoubtedly integral portions of the same magma from which the more usual or prevailing granite-gneiss has solidified.

Var. (b) Dioritic Gneiss: Amphibolite.—It has been thought advisable for the purposes of distinction to use this term 'dioritic gneiss,' not as implying any difference in origin, but simply denoting that the rock thus classified does not form an integral or highly differentiated portion of the same magma from which the ordinary gneisses have solidified. It frequently occurs interfoliated, and often in dike-like forms, evidently representing portions of some pre-existing basic irruptive which has undergone excessive crushing and consequent recrystallization, as a result of the subsequent intrusion of the associated gneissic rocks classified as Laurentian. Macroscopically these rocks are fine-grained, very dark greenish-grey (almost black) in colour, with distinct foliation and schistosity. When broken the fresh surfaces show brightly glistening crystals and plates of hornblende and mica. The rock examined is composed chiefly of compact green trichroic hornblende and plagioclase. As is often the case with rocks which have undergone similar extensive recrystallization the triclinic feldspar present is very clear and glassy, showing a frequent and marked absence of the twinning or pressure lamellæ. When these are present, however, the extinction-angles shown are those characteristic of labradorite, while some of the unstriated grains may possibly represent orthoclase. The quartz present is proportionately very subordinate in quantity, and is often with difficulty distinguishable from the clear and sharply extinguishing feldspar. The biotite present occurs in intimate association with the hornblende, sometimes forming parallel intergrowths with this mineral; garnet and ilmenite, the latter mineral often surrounded by sphene, are likewise present. In several instances the same rock was traced directly and continuously into larger areas of practically unaltered gabbroic or diabasic material, of distinctly earlier genesis than the gneiss in which they are embedded.

Minerals of the Gneissic Rocks.

The minerals observed in the acidic and basic gneissic rocks are the following:—

Quartz
Orthoclase
Microcline
Plagioclase
Biotite
Hornblende
Epidote
Muscovite
Chlorite
Pyrite
Calcite
Sericite
Apatite
Titanite
Zircon
Garnet
Magnetite
Hematite
Ilmenite
Leucoxene
Limonite
Zoisite
Talc
Tourmaline
Allanite
Rutile
Cyanite
Graphite
[illegible]
Augite

Of these the quartz, orthoclase, plagioclase, biotite, hornblende, epidote and muscovite may be regarded as essential, and the remainder either accessory or secondary constituents.

Classification of Gneissic Rocks mapped as Laurentian on the Nipissing and Timiskaming Sheets (Nos. 131 and 138), showing their relations to the Normal Massive Types of Igneous (Plutonic) Rocks.

A. MASSIVE IGNEOUS (PLUTONIC) TYPES.			B. GNEISSIC EQUIVALENTS.	
ACIDIC DIVISION.				
I. GRANITE.	GRANITE, proper.	=	**A.** GRANITE-GNEISS.	
	MUSCOVITE GRANITE.	=	**B.** MUSCOVITE-GRANITE-GNEISS.	
			C. GRANITITE-GNEISS.	
	GRANITITE.	=	I. Micaceous.	
			var. (*a*) Biotite and Epidote	A. Fresh and unaltered. Epidote nearly all primary* B. Crushed and altered. Much secondary epidote.
			var. (*b*) Biotite with little or no Epidote.	
			var. (*c*) Biotite, with Cyanite, Garnet, Graphite, etc.	
			II. Hornblendic.	
			var. (*d*) Hornblende and Biotite.	
	HORNBLENDE-GRANITE.	=	**D.** HORNBLENDE-GRANITE-GNEISS.	
II. SYENITE.	MICA-SYENITE.		MICA-SYENITE-GNEISS.	
BASIC DIVISION.				
III. DIORITE.	MICA-DIORITE. Quartz-Mica-Diorite.	=	Quartz-Mica-Diorite-Gneiss.	Var. (*a*) Quartz mica diorite gneiss, integral and extremely basic portions of the same magma from which the more common granite gneisses have solidified. Var. (*b*) Dioritic Gneiss Amphibolite, representing interfoliated basic irruptives, which, of earlier genesis, have been crushed and recrystallized by the intrusion of the ordinary or prevailing gneissic rocks.

*Primary epidote is present in both A1 and B1, but in B1 it is largely mixed with secondary epidote derived from the alteration of the feldspar. Primary epidote is likewise very constantly present in the quartz-mica-diorite gneisses, the crystals being both sharp and perfectly developed.

Quartz.—This is, in general, a very abundant mineral in the gneisses of the district. Only in a few cases were granitic specimens observed in which the absence of quartz would lead to their being grouped with the syenites. It enters largely into the composition of the basic rocks, allying them to the quartz-diorites and quartz-mica-diorites. In its general character it does not differ from the ordinary granitic variety, but is, of course, much crushed, stretched and granulated in those gneisses which have been subjected to intense dynamic action.

It appears to fill in the spaces between the feldspar of the rock, and, consequently, to have crystallized out of the magma after they were formed. This is especially noticeable in many of the basic or dioritic gneisses. Distinct crystals of quartz have not been observed in the rocks examined, the mineral occurring in the form of irregular grains.

The quartz grains, as usual, always exhibit the effects of dynamic action in a much more marked degree than do the feldspars. A granophyric intergrowth with feldspar is of very common occurrence. Inclusions are frequent. Sometimes the quartz occurs in grains scattered through hornblende, the individual grains having no regular arrangement or orientation with respect to one another or to their host. Such a structure has been named 'poikilitic' by the late Dr. George H. Williams.*

Orthoclase.—This is the most abundant of the feldspars which occur in these rocks. It usually forms irregular grains interlocked with the other feldspars and quartz, although in a few instances porphyritic individuals occur, which are sometimes twinned. It is seldom quite clear and fresh-looking, but usually turbid in appearance, and more or less filled with little scales of sericite and granules and crystals of epidote and zoisite, the products of its decomposition.

In those specimens representing rocks which have evidently been subjected to intense dynamic action the orthoclase shows a marked tendency to pass into microcline. Inclusions of the other minerals present in the rock are of frequent occurrence, and intergrowths with triclinic feldspars were also noted. It is often stained with hydrous oxides of iron, giving brownish or reddish tints to the rock. In common with the other feldspars it has escaped to a large extent the results of dynamic action, rocks in which the quartz has been completely granulated frequently preserving large grains of the feldspars which show only a few cracks and a more or less pronounced undulatory extinction.

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*On the Use of the Terms Poikilitic and Micropoikilitic in Petrography; Journal of Geology, vol. I, No. 2, pp. 176-179

Microcline.—This is a very abundant constituent of the granitic gneisses, especially of those which have been greatly crushed and granulated. Teall has recently announced that the result of his investigations of the microcline in the older Deeside (Cairnshee) granite of the Highlands of Scotland 'lend no support to the view that microcline may be developed from orthoclase by dynamic or any other action, but are in accordance with the theory of Michel, Lévy and Mallard, that orthoclase is microcline in which the polysynthetic twinning is on a sub-microscopical scale.'

The constant relationship which exists between the quantity of microcline in a given rock and the degree of pressure to which the rock has been subjected, as brought out by microscopic examination, is of too marked a character to be ignored, and instances may frequently be observed, where, when a large individual of orthoclase has been peripherally granulated, the fragments detached from the parent individual show to perfection the typical cross-hatching of microcline, whilst the centre is quite free from striations and exhibits the ordinary characters of orthoclase. There is not, in such instances, a gradual transition from one structure to the other, the cross-hatching in the detached bit of granulated material next to the parent individual terminating as abruptly against the fractures which separate them from it as do the striæ induced by pressure in a plagioclase individual against cracks traversing the crystal. Where evidences of pressure are unmistakably present, but fracturing has not actually taken place, the gradation may be seen from the normal orthoclase, through a 'moire structure' to the typical cross-hatching. Plate IV., Figs. 2 and 3.

Thus, whether microcline and orthoclase be identical or dimorphous, (a question which cannot be discussed here) the scarcity of the former in unaltered rocks, and its marked abundance in those which have been subjected to pressure, together with the peculiar manner in which it has been observed to occur in individual instances mentioned above, seems to prove rather conclusively that microcline structure at least can be, and is, produced in the feldspar now known as orthoclase and not showing that structure as the result of pressure. It is, too, reasonable to suppose that, if orthoclase be microcline with a sub-microscopic twinned structure, we should find various gradations in the same section from the microscopically invisible structure, through exceedingly fine striation, to the distinctly visible and sometimes quite coarse structure characterizing what we call microcline.

Instead of this we find that when a crystal which we call orthoclase is subjected to pressure a peculiar wavy structure appears in it, analogous to the strain shadows of quartz as seen in the thin section; the grain or crystal, when carefully examined under the microscope, being evidently under strain and undergoing deformation. This wavy structure gradually merges into the typical cross-hatched one. In fact many of the arguments advanced and facts cited in favour of the theory that microcline and orthoclase are identical seem to point strongly to the conclusion that this is not the case, but that microcline represents a re-arrangement of the orthoclase molecule induced by pressure.

Cases where areas of feldspar with typical microcline structure occur, included in unaltered and uncrushed orthoclase individuals, may be regarded as analogous to intergrowths of the ordinary triclinic and monoclinic feldspars.

Plagioclase.—In the granitic and syenitic gneisses plagioclase is tolerably abundant, in the case of the mica-syenite-gneiss from Cross lake constituting nearly one-half of the feldspar present. No direct chemical determinations have been made, but when the angles of extinction have been measured these indicate that the feldspar is either an oligoclase or an andesite.

As a general rule the proportion of the plagioclase present increases with the basicity of the rock, and it, of course, predominates in the diorite-gneisses of the region. In these rocks it is, apparently, chiefly a labradorite. It is usually well twinned, this twinning being due to pressure in many cases.

Alteration to calcite was frequently observed, also typical saussuritization of the more basic varieties, with formation of zoisite, epidote and sericite. Poikilitic and micropoikilitic structures are sometimes seen.

In some of the basic gneisses which may possibly have resulted from the metamorphosis of a basic irruptive the feldspar is frequently very clear and glassy, with numerous unstriated grains which are, however, probably plagioclase. It is somewhat difficult, in such cases, to distinguish between the glassy feldspar and the quartz.

Biotite.—This is by far the most abundant ferro-magnesian constituent of the granitic and syenitic gneisses, and also enters quite freely into the composition of the basic varieties. The primary biotite occurs in two forms, as large broad plates aggregated together, and as isolated smaller plates having a general parallel arrangement in the rock.

Crystals with perfect crystallographic boundaries were not observed. Mechanical deformations of the plates are well seen in rocks which show the general effects of dynamic action.

In most instances it is remarkably fresh and is intimately associated with epidote, large, fresh, isolated crystals of which are frequently enclosed in the unaltered biotite. In colour it is usually a deep reddish-brown, in some cases inclining to a copper-red, and is very strongly pleochroic, from pale straw-yellow to a deep reddish-brown. When more or less altered to chlorite it assumes various tints of green.

Occasionally, in the hornblende-granite-gneisses and diorite-gneisses, it is intimately associated with the hornblende. In those rocks which contain both micas the biotite and muscovite occur intergrown with each other, the plates of each variety being sharply defined.

Frequently, however, by a leaching-out process, the iron has bee so far removed from the biotite as to cause it to assume a very ligh colour; indeed in some sections it is difficult to determine whethe certain individuals are to be regarded as bleached biotite or as origina muscovite.

In addition to the biotite, which is of undoubted primary origi little scales of secondary biotite may often be observed developed alon shear-planes in certain of the greatly crushed and stretched gneisse The biotite holds numerous inclusions of apatite, zircon, &c., whic are commonly surrounded by dark, pleochroic halos.

Hornblende.—This appears to be a comparatively rare mineral i those granitic and syenitic gneisses which have been examined fro this region. In two instances it is tolerably abundant, but in mo cases where it has been observed only one or two minute grains cou be detected in a single thin section of the rock.

In the basic or dioritic gneisses it is, of course, a very abunda mineral. In these rocks it occurs as the compact variety chief actinolitic forms being rare. It forms, as a general rule, rath irregular individuals aggregated together, although occasionally so may be seen having well defined crystallographic boundaries.

It possesses good cleavage and is very strongly pleochroic. T absorption is usually $\mathfrak{c} > \mathfrak{b} > \mathfrak{a}$ generally $\mathfrak{a}$ = greenish yellow =dark yellowish green, and $\mathfrak{c}$ = deep bluish-green. Twinning is common feature of the mineral.

The hornblende is always intimately associated with the biotite a epidote when these latter minerals are present in the rock. In seve instances the extinction angle was measured and found to vary fr 17½° to 19°.

Inclusions of feldspar, quartz, zircon, apatite, titanite, &c., are v common and are frequently arranged in such a manner as to give the hornblende-gneiss a typical micropoikilitic structure. Plate

Fig. 1. As in the case of the biotite the inclusions of apatite and zircon are often surrounded by well defined pleochroic halos. Alteration to chloritic and epidotic material was observed, accompanied by the deposition of carbonates.

No instances of augite cores occurring in the hornblende were noticed, nor any direct evidence of the latter mineral having originated from the former; although in some few instances this might be suspected from the fact that the interior of the crystal is of a paler colour than the exterior portion.

Epidote.—Next to the biotite this is by far the most abundant of the coloured constituents of the granitic gneisses, and it also enters largely into the composition of the more basic hornblendic ones. In addition to the ordinary occurrence of the epidote as an alteration product we have also the strongest evidence that it exists in a large number of cases as an original and important constituent of the rock mass.

The manner in which the perfectly fresh crystals possessing sharply defined outlines occur, enclosed by wholly unaltered biotite in rocks which have been subjected to only a slight degree of pressure, admits of no reasonable doubt as to their primary nature. An inspection of the accompanying plate, (Plate II., Fig. 2), will bring this point out very clearly. The mineral is usually of a bright yellow colour, very strongly pleochroic, and possessing the usual high relief and brilliant polarization colours, except in sections parallel to the orthopinacoid, which exhibit bluish and yellowish tints between crossed nicols. It occurs both in crystals and irregular grains, the former often having, as already stated, very sharply defined outlines.

The corrosion phenomena noted by Dr. Adams in epidote from the Yukon river* are shown to perfection in some of the individuals. The crystal sections are usually bounded by the prism planes M, r, and T. Good cleavages were observed parallel to M and T, the angle between them being about 115°.

Twins are of common occurrence. The crystals occasionally contain cores of a pleochroic brownish substance which is probably allanite, but no thoroughly typical examples of that mineral were detected.

Nondescript cores, which may represent augite surrounded by rims of epidote, were occasionally seen in the thin sections. Secondary epidote frequently occurs in the groundmass of the more altered rocks, associated with chlorite, as the result of the mutual reaction of the feldspars and bisilicates. It also forms small crystals and granules in the decomposing feldspars, together with zoisite, sericite and carbonates, as one of the products of their saussuritization. Many cases occur in highly granulated rocks where it is almost impossible to say what is primary and what secondary epidote. Frequently, however, in rocks which have suffered extreme crushing and are filled with secondary epidote granules, large epidotes may be observed broken and faulted like the other constituents, proving that they existed before the rock was subjected to the dynamic action.

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*Can. Rec. Sc. vol. IV., pp. 344-358, 1890-91, also Annual Report Geol. Surv Can vol. III. (N.S.), Part I, Appendix V (N.S.), p. 237 B., 1887-88.

Muscovite.—Both primary and secondary muscovite occur in these gneisses, and it is often difficult in a particular instance to determine to which of these two classes the mica is to be referred. Frequently broad fresh laminæ of muscovite are intimately intergrown with deep brown fresh biotite, and in such cases are undoubtedly of primary origin.

The variety of the mineral referred to here is muscovite proper, occurring in broad plates or laminæ, as distinguished from the fine scales of sericite resulting from the alteration of plagioclase, &c. It possesses the usual bright polarization colours and other physical characters common to the species, and no unusual features were observed in the specimens examined.

Chlorite.—(Taken as a general group name).—This is the common alteration product of the biotite and hornblende of these rocks. It polarizes in the usual dull bluish tints.

Many of the gneisses owe their green colour to this mineral, which gives them a very deceptive appearance, acid granitic rocks very often closely resembling, at first sight, some massive altered basic irruptive.

Pyrite.—Is of common occurrence in all the gneisses, particularly in the more basic ones. The red and brown oxides of iron which so frequently stain the rocks can often be traced to this source.

Calcite.—This mineral is abundant where alteration of soda-lime feldspar has proceeded to any extent. In such cases it forms large, irregular, brilliantly polarizing patches throughout the thin section.

Its abundance in some specimens, *e. g.*, in the hornblende-granite gneiss from the south end of Opimika narrows, is rather remarkable, as this rock does not seem to have been greatly altered. In such instances it may possibly be of primary origin.

Sericite.—This is an abundant product of the saussuritization of the feldspars, forming fine, brilliantly polarizing scales, intimately associated with zoisite, calcite, &c. Some of the material referred to as sericite in the description of these rocks may possibly be talc, as it is difficult to distinguish between these two minerals under microscope.

Apatite.—This mineral is of frequent occurrence in the acidic and basic gneisses. It is mostly in the form of stout and short or long and slender prisms, but grains with extremely irregular and more or less rounded outlines also occur. The large stout prisms are especially characteristic of the diorite-gneisses.

Titanite (Sphene).—Remarkable crystals of this mineral were observed in some of the rocks examined. They are of unusually large size, deep clove-brown in colour, and intensely pleochroic, and, as is usual in such dark-coloured varieties, exhibit their brilliant interference colours to perfection. Twinning was frequently observed.

The mineral is especially abundant in those rocks in whose composition hornblende occupies a prominent place. It occurs in irregular grains of varying size, as well as in the well formed crystals just mentioned. Little crystals were observed penetrating the epidote crystals and also included in hornblende and biotite. It frequently forms fine-grained granular aggregates of considerable size, and is present in nearly all the rocks described, both basic and acidic.

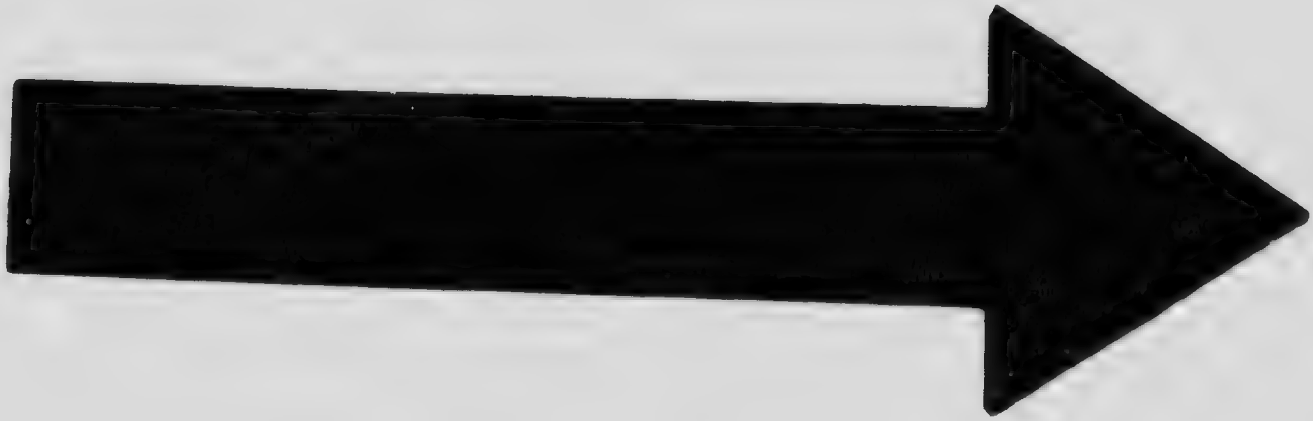
Zircon.—This mineral is also of widespread occurrence in the gneisses. The crystals are usually well developed, and often of large size. When embedded in the biotite or hornblende it is usually surrounded by a pleochroic halo.

Garnet.—This is by no means as abundant a constituent of the gneissic rocks of this region as was formerly supposed, although in some localities it is extremely plentiful. It occurs in the granitite-gneiss containing cyanite, and also in several of the more or less altered basic-gneissic hornblende rocks. It is usually in fresh irregular grains and aggregates, frequently of large size, much fractured, and of a light pinkish colour in thin sections. The optical anomalies which have elsewhere been frequently noted were not observed in the present instances, all the grains appearing to be completely isotropic. Distinct crystals were very rarely seen.

Magnetite.—As stated elsewhere the scarcity of iron ore in the granitic gneisses is a remarkable feature in their composition. In a few instances isolated grains were tested and found to be magnetic.

Hematite.—This is frequently present in the form of thin plates with hexagonal outlines, and in irregular scales. It is often developed along the cleavage planes of the biotite.

Ilmenite.—Generally speaking this is the iron ore which is present in the diorite-gneisses, and is almost invariably accompanied by its alteration product, leucoxene. It may be regarded as one of the essential ingredients of these rocks. The peculiar brownish tints so noticed



MICROCOPY RESOLUTION TEST CHART

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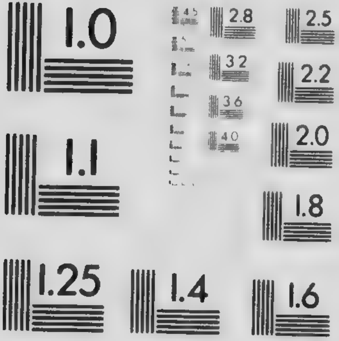

APPLIED IMAGE Inc

often seen in the plagioclase are probably very often due to dust-like particles of this mineral included in them.

Leucoxene.—This is always an alteration product of titanic iron ores or rutile. The grains of ilmenite are sometimes completely replaced by whitish or yellowish almost opaque masses of this mineral. A peculiar cross-hatched structure was sometimes observed, probably due to sagenitic growth of rutile which previously existed in the ilmenite individual from which the leucoxene was derived.

Limonite.—The irregular deep-brown stains which frequently permeate the various minerals, especially the feldspars, are probably in most cases due to the presence of this mineral.

Zoisite.—Accompanies epidote as the result of saussuritization o the feldspars, usually in quite small individuals which present n unusual features.

Talc.—In a few of the more squeezed and altered gneisses scales were observed which seem to correspond in their general characters with this species, as distinguished from sericite, but it is difficult to discriminate between these two minerals.

Tourmaline.—Two or three columnar strongly pleochroic indi viduals of this mineral were observed in one of the gneisses examined

Allanite.—Whilst not particularly abundant many good exampl of this mineral were observed, more especially in those granit gneisses in which idiomorphic primary epidotes are plentiful. I occurs in the reddish-brown pleochroic individuals in the centres epidote crystals with which it is in parallel orientation. These occ rences are of precisely similar character to those described by Hobb in the Maryland granites.

Rutile.—This mineral was observed in a few instances in the f of very minute, slender needles penetrating the biotite.

Cyanite.—Occurs in rather short flat-bladed crystals, which rare show sharply defined faces in the prism zone, commonly formi irregular columnar individuals. A few of the smaller crystals sh terminations, but with very rough faces.

The colour is usually light-bluish or greenish, but occasion crystals show a deep blue centre with a white margin. Some in viduals measure half an inch across and an inch in length. It is b developed in those portions of the rock which are free from biot and consequently of a lighter colour. In the darker portions of rock it is frequently intergrown with the biotite. The individ are often bent and hold many inclusions, particularly of pyr biotite, quartz and graphite.

Under the microscope the sections are transparent and generally colourless, but patches of a light-blue colour occur here and there. These patches exhibit a pleochroism (light-blue to colourless) which is not noticeable in the colourless portions of the crystals. The cleavage parallel to M and T does not traverse the entire section as a rule. In longitudinal sections the parting parallel to P is also clearly shown. As is invariably the case the cyanite is accompanied by garnet.

Graphite.—This mineral occurs in some quantity in the cyanite-gneiss in the form of irregular flakes, rarely with rude hexagonal outlines. A few flakes were observed to be nearly a quarter of an inch in diameter.

Fibrolite.—Only a few specimens of the cyanite-gneiss were collected from the cuttings on the Canadian Pacific railway in the vicinity of Les Erables rapids and Snake creek, on the Ottawa river, and these show no fibrolite, but it is almost certain that this mineral, which accompanies the cyanite in the similar rock from near Wanapitei station, will be found associated with it in the area.

Augite.—This mineral, as elsewhere noted, is almost, if not entirely, absent from those gneisses which have been microscopically examined. In certain specimens a few skeleton forms, entirely filled with alteration products, were observed, which may originally have been pyroxene, but this is by no means proved. The hornblende was carefully examined to see if there were any traces of pyroxene cores in it, but no certain evidence of this was obtained, although in some cases it was observed that the exterior of the hornblende individual was of a darker colour than the central portion.

GRENVILLE SERIES.

The name Grenville Series was the distinctive title applied in 1863[*] by Sir William Logan to the series of crystalline rocks so extensively and well exposed in the region on the north side of the Ottawa in the vicinity of the Augmentation and village of Grenville. These were referred to as Middle Laurentian and supposed to conformably overlie the Lower Laurentian or Fundamental Gneiss. The rocks thus classified comprise a great variety of gneisses with which are associated considerable volumes of crystalline limestone, and a detailed map was published showing the distribution of the component bands.[*] Many reasons were adduced as evidence for regarding the whole series as greatly metamorphosed sedimentary strata. These proofs had reference chiefly to the banded or foliated character of many of the composing masses, believed to represent the surviving traces of the parallelism due to original sedimentation, the presence of large and important beds of limestone, together with the occurrence in some of these bands of forms described as representing organisms of [illegible] type. Subsequent examination in the field, supplemented by the detailed petrographical studies rendered possible by the recent perfection of the microscopic methods of research, have, however, revealed the fact that while certain of the fine-grained, light-greyish, rusty-weathering gneisses are closely allied in structure and composition to ordinary shale or slate, other rocks, representing a very much greater volume of the whole series, are undoubtedly the foliated equivalents of the ordinary plutonic irruptives.†

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[*] Geology of Canada, (1863), p. 839.

[*] Atlas, Geology of Canada, (1863). Map No. 1.

In the area covered by the accompanying map-sheets the line of subdivision between what has usually been regarded as Lower Laurentian and the Grenville Series was described by Sir William Logan, in 1844, as occurring somewhere in the vicinity of the Mattawa river. The supposed line of boundary was based on the occurrence at certain points of isolated masses of crystalline limestone, but these have since been found to be in intimate association with rocks which are believed, with some confidence, to be the foliated equivalents of ordinary granites and diorites.

In the area under description only one very limited occurrence of the fine-grained and evenly banded light-greyish gneisses usually associated with the Grenville series was noticed, consisting of a small band interfoliated with the ordinary reddish granite-gneisses, a little over two miles east of Rutherglen station on the Canadian Pacific railway. The strike of this band is about N. 20° W., with a dip to the northeast at a high angle. The hand specimen represents a fine-grained evenly foliated, rusty-weathering, greyish, graphitic gneiss. Under the microscope it is a fine-grained admixture of interlocking grains of feldspar, quartz, and a rather pale-coloured bleached biotite, together with smaller quantities of pyrite, graphite, rutile, and a mineral closely resembling zoisite in minute crystals, arranged in nests composed of aggregates of crystals and crystal fragments running parallel with the foliation. The rock has evidently been subjected to intense and long continued dynamic action, the foliation being pronounced, while the recrystallization has been so complete as to mask much of its original structure. It bears a marked microscopical as well as macroscopical resemblance to the sillimanite gneisses described by Dr. Adams.*

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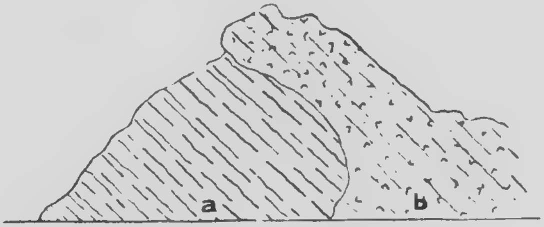
†Adams. A Further Contribution to our knowledge of the Laurentian, Am Journ. Sci., July, 1895.

The most important band of crystalline limestone noticed in the whole district occurs at the foot of Lake Talon, an important expansion of the Mattawa river. The presence of this band was first noted by Bigsby† in 1820, and later in 1844 by Logan. Dr. Bell, in 1876, also gave a short description of its mode of occurrence.‡ The rock consists of whitish crystalline limestone with small thickly disseminated specks and patches of green serpentine. It is first noticed on the south side of the lake a short distance above the outlet, occupying the points along the shore, while the massive reddish granitite-gneiss rises into rounded hills behind. The limestone, as far as can be ascertained on account of the massive texture of the gneiss, occurs as an interfoliation, dipping S. 8° E. < 25. Farther down towards the chute the rock contains a good deal of serpentine in addition to some other impurities, and occurs seemingly as a large irregular rounded patch in the gneiss. At the narrows, a short distance above the Talon chute, the contact between the crystalline limestone and massive rather indistinctly foliated red granite-gneiss is well shown, the former dipping N. 74° E. < 20° while the latter, with a nearly east-and-west strike, overtops or flows over the mass of the crystalline limestone, the indistinct foliation of the gneiss conforming in general with the line of junction between the two rocks. See Fig. 1.

FIG. 1.



Sketch section showing structure of crystalline limestone (a) and massive red granite gneiss (b), near Talon chute, Mattawa river.

At the Talon chute there are two channels by which the lake discharges into the gorge below. The largest of these channels is situated near the north side, while the southern one has been excavated along a band of ophicalcite, seventy feet in thickness, intercalated with the gneiss and dipping in a southerly direction < 25°.

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al Report, Geol. Surv. Can., vol. VIII. (N.S.), Part J.
and Canoe. vol. I. London, 1850.
Report of Progress, Geol Surv. Can., 1876-77, p. 207

Smaller bands and patches of crystalline limestone likewise occur on three of the Manitou group of islands in the eastern portion of Lake Nipissing. On the west side of the most southerly of these islands beds of a beautiful light salmon-pink crystalline limestone occur, containing radiating crystallizations of dark-green hornblende, black biotite, and yellowish-green epidote. The strike is about N. 80° E. and the angle of dip is about 65°. This is associated with the prevailing rather fine-grained dark-reddish and green granitite-gneiss.

On the east side of the Great Manitou island (Newman island), a few chains south of the northeast point, there is a layer or bed of pinkish limestone, weathering yellow, reddish and greyish. The strike of the dark-red and green granitite-gneiss is about S. 60° E. and the dip southeast < 45°. On the west side of the most easterly of the Manitou islands, about the centre of the island, beds and patches of pinkish and whitish limestone are embedded in the dark-red and green granitite which has a strike of S. 5° E. and a dip to the east < 45°.

HURONIAN.

The name Huronian was adopted by Sir William Logan and Dr. T. Sterry Hunt in 1855* to include the clastic rocks believed to overlie the Laurentian gneisses in the districts adjacent to Lakes Huron and Superior.

The area included by the present report exhibits large tracts of country underlain by pyroclastic and epiclastic rocks identical in lithological character with those described as Huronian by Murray in 1856. It forms, in fact, the northeasterly extension of the same belt, which has been traced with practical continuity from what is generally termed the 'typical' area on the north shore of Lake Huron. The inclusion of these rocks under the name 'Algonkain,' shows a tendency on the part of some geologists to revert to the erroneous grouping of Huronian, Animikie and Keweenawan as integral portions of a single system or series of formations, in spite of the pronounced haitus known even then to exist, though perhaps not appreciated to its full extent by Sir William Logan. As has been pointed out by Dr. Dawson † and others, the proposed use of the term Algonkian in the same extended sense is both unnecessary and misleading, and it should therefore be deprecated. Its adoption disregards not only the zealous and accurate work of many trained observers over extended areas characterized by the presence of these

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*Esquisse Géoligique du Canada. Paris, 1855, p. 29.

†Presidential Address to the Geological Section, B.A.A.S., Toronto meeting, 1897.

Archæan rocks, but would also supplant a useful and well known term, of which the priority remains unquestioned, by a name which is at once needless and indefinite. No attempt has been made to correlate the rocks here described as Huronian with certain series or groups which have been lately and ably reported upon under the new conditions since the use of the microscope has made an accurate description of the various component rock masses not only possible but imperative. It is also regarded as premature as yet to anticipate the results of further and more complete microscopical and stratigraphical examinations of the Huronian, Grenville, Hastings, Keewatin and Coutchiching series.

The Huronian rocks, which are extensively and widely developed in the northwestern part of the region under description, naturally admit of a three-fold sub-division, the component members following one another in undisturbed succession, each showing a gradual and perfect transition upward into the succeeding member. The rocks occur for the most part in slightly undulating anticlinal and synclinal folds, except in the vicinity of certain large irruptive masses, where considerable disturbance as well as alteration is found as a result of their intrusion. At the base of the series is a breccia-conglomerate, containing pebbles and fragments, often angular, though usually subangular or rounded in outline, of granitite, diabase, diorite, etc., embedded in a matrix composed of the same materials in a finer state of division, while the more minute interstices are filled up with scales and flakes of chlorite and sericite. Where this matrix forms a considerable portion of the rock, the abundance of these decomposition products gives a prevailing dark-green colour to the whole mass. This rock has in previous reports been referred to as 'slate conglomerate' or 'chloritic slate conglomerate,' a name first proposed and used by Logan.* This coarse fragmental rock passes upward into a dark greenish-grey greywacké or feldspathic sandstone, in which few if any fragments are macroscopically apparent. This in turn merges above into an exceedingly compact and fine-grained rock of essentially similar composition, which gradually assumes a banded and slaty character, the planes of cleavage, when present, corresponding in most instances with the evidences of original sedimentation as revealed by the colour stripings. Superimposed upon these, usually without any sharp line of division, although at times there is an abrupt change, is a quartzite-grit, made up chiefly of fragments of granitic quartz with some of feldspar, all usually more or less rounded and continued in a feldspathic matrix, now largely altered to yellowish-green sericite.

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*Report of Progress, Geol. Surv. Can., 1845-46, p. 67.

The rock is generally yellowish-green in colour owing to the abundance of sericite, the scales of which are often macroscopically apparent in the matrix. On this account it has been usual to refer to the rock as a sea-green quartzite. Occasionally it is of a flesh-red colour, when it is with difficulty distinguished from ordinary granite. It occurs in massive much jointed beds, the stratification at times being shown only by a parallel disposition of certain coarser or conglomeratic bands. It is occasionally fine-grained but usually approaches the character of a grit or fine conglomerate.

Until very recently it was a matter of general belief, based on previous descriptions and reports, that the source of such clastic material was to be traced to the breaking down of the gneissic or foliated crystalline rocks usually classified as Lower Laurentian. The writers repeatedly insisted that gneissic pebbles, distinctly referable to the Laurentian, formed the most abundant coarse fragmentary material in the basal beds of the Huronian. Later geological research in this and neighbouring Archæan areas has shown, however, that such statements are largely erroneous, as foliated fragments are only very occasionally represented and in most cases are entirely absent, while those of a somewhat coarse-grained aplitic granite make up the greater portion of many of these conglomeratic rock masses. The examination likewise of the line of junction between the gneisses and the granites constituting the Laurentian of this district on the one hand, and the breccia-conglomerates and slates of the Huronian on the other, has shown that the former were in a plastic or softened condition after the hardening of the Huronian sediments.*

Most geologists were inclined, despite these opposing facts, to believe that the Laurentian gneisses and granites constituted the original floor or basement upon which the Huronian sediments were deposited and from which their material was derived. The present attitude of these rocks, moreover, was explained as due to the instability of the earth's first-formed crust allowing and favouring a settlement of any overlying clastic material, accompanied as it must have been by frequent and repeated upwellings of the molten magma from beneath. These unsettled conditions were further accentuated by extensive fracturing and crumpling as a result of the earth's secular refrigeration, all combining to bring about the conditions and phenomena now witnessed along the line of junction between the Laurentian and Huronian rocks.

Careful search has been made for localities in which the underlying basement might have escaped this seemingly wide-spread disturbance, but apparently in vain. Pumpelly and Van Hise* have described what they have called a basal conglomerate reposing upon a fundamental complex of crystalline schists and granite, as exhibited on two small islands near the north shore of Lake Huron, a short distance east of Thessalon, Ontario. A difference of opinion, however, exists concerning the interpretation of this section, and the fact that the granite from which the pebbles in the conglomerate are believed to have been derived pierces and alters the slaty rock overlying the conglomerate, seems to show clearly that the correlation of the granite with that constituting the pebbles in the conglomerate is decidedly at fault.†

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*Vide ante, also American Geologist, July, 1890, pp. 19-32. Bull. Geol. So Am., vol. IV., pp. 313-332.

In spite, however, of the generally irruptive character of the line of junction between the Laurentian and Huronian, it was confidently anticipated by even those who believed in the intrusive character of the Laurentian gneisses that in some place an undisturbed contact would be ultimately found. The detailed geological examination of the region to the northeast of Lake Huron, carried on for the last ten years by the author of this report, has furnished abundant proofs of the pyroclastic character of the rocks composing the two lower members of the Huronian. The breccia-conglomerate, greywacke and slates evidently represented the graded forms resulting from the consolidation of volcanic ejectamenta showered out and spread upon the bottom of a shallow ocean, and there somewhat rounded and otherwise modified as a result of aqueous action. In many cases, however, these rocks are so intimately associated with materials resulting from processes of ordinary aqueous erosion and deposition, that, in most instances, it is extremely difficult if not impossible to make a separation. The fragments contained in the breccia-conglomerate are, as has been shown, composed of rocks of igneous or plutonic origin and in no way distinctly referable to any Laurentian strata now exposed at the earth's surface in the same area, while the frequent intimate association of this coarse fragmental rock with large masses of dia-[illegible] and granitite, cannot be regarded as merely accidental. [illegible] part of the Huronian period in this district was evidently [illegible] intense and long continued volcanic activity, and the great-[illegible]n of the rocks representing this lapse of time are pyroclastic in character.

True sedimentation on a large scale seems only to have been ushered in towards the close of the period, and the quartzite-grits and conglomerates prevailing towards the summit of the series are very typical examples of epiclastic material.

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*Am. Journ. Sci., III. vol. XLIII. pp. 224-232. March, 1892; also III. vol. XXXIV, 1887, pp. 207-216.

†Am. Journ. Sci., III. vol. XLIV., 1892, pp. 236-239; also Bull. Geol. Soc. Am. vol. IV., pp. 330-332

The relations found to exist between this arkose and an underlying fundamental biotite-granite or granitite, as exposed on either side of Lake Timiskaming in the vicinity of Baie des Pères, indicate its derivation to be a result of the disintegration and degradation *in situ* of the underlying granite, showing a gradual and uninterrupted passage outward and upward from the parent mass. The nature and import of this passage was the subject of an illustrated paper prepared by the author and Mr. W. F. Ferrier, and presented at the Toronto meeting of the British Association for the Advancement of Science in August 1897.* A short resume of the interesting phenomena observed has already appeared in the Geological Magazine,† but the details, not only of the field relations of these rock masses but also of the petrographical examinations, will be found in that portion of this report dealing with the geological description of Lake Timiskaming. The relations between this granite and arkose are of rather unusual scientific interest, showing as they do the pre-Huronian existence of a basement or floor upon which these sediments were laid down and which in this portion at least has escaped the movements to which the Laurentian gneisses have been subjected.

The petrographical studies undertaken with the object of determining the origin, composition and minute structures of the various rock masses making up the bulk of the Huronian have been so numerous and detailed that it is impossible in the present report to give at length the description of each separate slide, especially as many of these prepared from specimens obtained at widely separated localities were afterwards ascertained to represent rocks presenting no essential points of difference. It will, therefore, doubtless be found sufficient to give a general description of each of the three members constituting the Huronian, at the same time pointing out the nature of the transitional sequence so frequently witnessed from one rock to the other.

Breccia-conglomerate.

The rock thus designated is identical with the 'slate conglomerate' or 'chloritic slate conglomerate' of the earlier reports of the Survey, described by Logan as following the Laurentian orthoclase-gneiss on Lake Timiskaming. The new name as proposed is preferred, as it indicates at once what is now confidently believed to be the true nature and origin of the large and important rock masses to which it is applied. This rock, especially where the finer matrix is abundant, is usually of a dark-greenish or greenish-grey colour, the colour deepening in proportion to the quantity of the greenish decomposition products which may have been developed. The immediate outer coating weathers from yellow through brown to almost black, although certain surfaces not exposed to the continued action of the atmosphere retain a light olive-green appearance. Beneath the decomposed surface is a layer, usually about one-eighth of an inch in thickness, composed of pale-yellowish decomposed material which evidently represents the usual saussurite products resulting from the alteration of the large quantity of feldspar present in the rock. As a rule the rock is extremely massive, showing little or no evidence of lamination or stratification, while the coarser fragmental material is arranged in such a heterogeneous manner that it is exceedingly difficult to ascertain with any degree of certainty either the angle or direction of dip. Sometimes, however, it has a slaty or foliated structure as a result of pressure, and this is in most cases the only structural feature discernible. These planes, which evidence intense and long continued pressure, are inclined usually at very high angles, the strike corresponding in direction with the line of outcrop of neighbouring intrusive masses, while the irregular curving lines of foliation produced by the unequal resistance to pressure simulate in a most marked manner the uneven lamination resulting from original bedding. It is, therefore, not surprising that in many descriptions of exposures of similar rocks such a structure has been repeatedly mistaken for stratification, the descriptions asserting the frequent and usual highly tilted character of these rocks.

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*On the Relations and Structures of certain Granites and Associated Arkoses on Lake Timiskaming, Canada, Rep. B A A S., Toronto, 1897, pp. 656-660.

†Geol. Mag., New Series, Decade IV., vol V., No. 1, pp. 39-41, January 1898

Although the slaty cleavage, especially in the upper portion of this rock, occasionally corresponds with the original stratification, there is no necessary connexion between the two. The hardness of this rock varies widely, the least altered or more quartzose varieties being exceedingly hard, while those exposures in which a large amount of chlorite and other greenish decomposition products have been developed are so soft that they can be readily scratched. Both as a massive rock, and in its more imperfect forms of slaty structure, it exhibits the character of a conglomerate, carrying fragments of various irruptive material which vary in size from the smallest pebble to some boulders a foot or even more in diameter. In some localities the rock is so full of these fragments that very little of the finer interstitial matrix is apparent, while in other places only an occasional one is found. Usually the fragments are more or less perfectly rounded; often they are subangular, while in some outcrops these larger individuals present sharp and often re-entering angles. The breccia conglomerate presents all the characteristics usually assigned to a rock resulting from the consolidation of an ordinary littoral deposit derived from the breaking down of an area of irruptive rocks of both acidic and basic composition. The wide area, however, over which the fragments are distributed, the composition and outline of many of the larger individuals, as well as the frequent intimate association with large masses of diabasic and gabbroic rocks, are incompatible with such an interpretation of the manner of its formation.

It is often exceedingly difficult to distinguish between true conglomerates or those representing the solidification of extremely local shore deposits and agglomerate-breccias which may have a much more widespread distribution, but in some instances the most typical conglomerate phase, containing perfectly rounded and [illegible] waterworn fragments, has been traced directly and continuously into areas in immediate conjunction with the parent masses where the contained fragments show no sign whatever of aqueous abrasion, the rock being a typical breccia. Many of the fragments, moreover, are composed of material which has probably been derived from beneath as a direct result of violent explosive action, as they cannot possibly be connected with any rock present at the surface in the region adjacent to these exposures.

The finer-grained portion, or matrix, of the least altered phase of this rock, possesses a rather typical clastic structure, although many of the fragments are often so irregular and angular in outline as to indicate clearly that they have not suffered the rounding or trituration to the extent that ordinary clastics of this kind exhibit. The rock is seen to consist mainly of granitic *débris*, the majority of the fragments being simple minerals; although coarser phases show occasional composite rock individuals. The minerals usually noticed are orthoclase, plagioclase, and more rarely microcline, embedded in a still finer-grained ground-mass of these same constituents, together with chlorite, sericite, epidote and zoisite, and occasional granules and broken crystals of zircon, sphene and apatite. Biotite and more rarely hornblende, both largely altered to chlorite, may also be sometimes distinguished, but fresh individuals belonging to these species are rather uncommon. Pyrite is a very frequent and often extremely abundant constituent, distributed through the rock in irregular grains and masses, but sometimes also in brilliant and well striated cubes. In many instances it may be noticed in various stages of its decomposition to hydrated oxide of iron or limonite. Ilmenite is likewise very often present, both in grains and crystals, usually more or less altered to leucoxene, and occasionally exhibiting the characteristic 'gridiron' form of this decomposition. Magnetite [illegible] particles and crystals is also rather commonly represented. In several instances broken fragments of crystals [illegible] ing the intense dichroism peculiar to this mineral, were [illegible] Occasionally, also, carbonate of lime is present [illegible] product of decomposition.

The quartz is usually in clear more or less rounded [illegible] ordinary granitic variety [illegible] degree, the [illegible] Some of the feldspar [illegible] other [illegible] what marked [illegible] various products of decomposition to which the [illegible] applied. Most, if not all, of the sericite present in the [illegible] derived from the alteration of the [illegible] mass being wholly decomposed [illegible] with epidote and zoisite. Fragments of feldspar [illegible] thitic intergrowth are rather abundant. [illegible] tion of the chlorite, which is almost invariably present, [illegible] from the decomposition of biotite, although some may have been [illegible] from hornblende originally present. The sericite occurs [illegible] part in the minute scales or matted aggregates [illegible] usually in large plates which are sometimes macroscopically apparent. The mineral varies from colourless to pale yellowish-green, showing brilliant chromatic polarization between crossed nicols. The chlorite and sericite usually serve as a finer interstitial [illegible] filling in the spaces between the quartz and feldspar grains. The epidote and zoisite occur in irregular granules and crystals, the former polarizing in brilliant colours while the latter, which is usually in more perfect crystals, shows the deep bluish or [illegible] characteristic of this mineral between crossed nicols. As a rule composite fragments, made up of two or more minerals occupying [illegible] original positions in the rock from whose waste they were derived, [illegible] rarely seen in this finer matrix, but with a progressive increase in coarseness of grain such fragments gradually appear. As a rule, even when small, these rock-fragments possess a more rounded outline than individuals made up of simple minerals which are very frequently quite sharp and angular.

In this matrix or ground-mass just described are embedded fragments, pebbles and sometimes even boulders of biotite-granite or granitite, hornblende-granite, diabase, diorite (?) quartzite and fine-grained slaty greywacké or hälleflinta-like rock, representing an extremely fine-grained mosiac of feldspar and quartz. Many of these larger fragments, as is usual in similar squeezed rocks, are surrounded by a rim of sericite and epidote, while occasionally, where the mass has been subjected to intense pressure and pronounced pneumatolytic action, as on Ko-ko-ko bay in Timagami lake, the whole matrix has been altered to a hydromica schist infiltrated with secondary silica, while the pebbles have undergone considerable stretching and deformation. Granitite pebbles and fragments are by far the most abundant and are almost invariably present where outcrops of this rock occur. In occasional localities individuals of diabase, which are next in point of general abundance, predominate over those of granitite. The granitite is usually of a distinct flesh-red or pink, sometimes reddish-grey and occasionally greyish colour.

It is commonly rather coarse in texture and more rarely pegmatitic. Macroscopically it shows a preponderance of pinkish feldspar, a much less proportion of greyish translucent quartz and a sparing quantity of a greenish ferro-magnesian mineral. A section prepared from one of the pebbles obtained from an exposure on Gull Rock islands in Lake Timiskaming showed the rock composing it to be greatly decomposed, the feldspar turbid, filled with sericite, epidote and calcite, and the bisilicates almost entirely altered to chlorite. Orthoclase apparently predominates, but plagioclase is abundant and microcline in small quantity also occurs. The quartz is the ordinary granitic variety, full of inclusions, and while possessing a somewhat wavy extinction does not show much further evidence of having been subjected to very intense dynamic action. A few little areas of granophyre were noted. The ferro-magnesian constituents originally present were probably both biotite and hornblende, but these minerals have been so completely altered to chlorite as to mask their tru optical characters. The former mineral doubtless predominated. Th change to chlorite has been accompanied by the deposition of muc secondary magnetite. Ilmenite is also present and is accompanie by leucoxene, while apatite is abundant.

The diabase fragments so frequently present are usually very fin grained, although sometimes so coarsely crystalline that the ophiti structure is distinctly discernible to the unaided eye. Occasiona pieces, still more coarsely crystalline and holocrystalline in structur may represent altered gabbros or diorites, but the ferro-magnesia minerals are all decomposed to chlorite. These pebbles are identic with those described as composed of a 'greenish feldspathic rock' i earlier reports. In every case examined they were found to be mu decomposed. A thin section of a fine-grained pebble, also from t Gull Rock island in Lake Timiskaming, shows the rock to ha undergone great alteration, the feldspar being saussuritized and the original augite decomposed to a pale-greenish chlorite. In spite, however, of this advanced alteration, the typical ophitic structure of diabase remains. Occasionally some of the feldspar has a broad tabular habit causing the rock to approach the gabbros in structure. The irregular areas between the plagioclase laths are filled with a felted mass of pale green chlorite scales. Leucoxene, resulting from the almost complete alteration of the ilmenite originally present in the rock, is plentifully scattered through the section. Other sections examined, belonging to much coarser grained fragments, were of essentially similar composition, revealing the same advanced alteration. The laths of plagioclase, decomposed to a partially opaque grey saussuritic mass, penetrated a matted aggregate of pale-green chlorite scales representing the allotriomorphic areas of augite originally present.

The ilmenitite has wholly disappeared, to be replaced by opaque greyish masses of leucoxene, showing the characteristic skeleton forms produced by the rhombohedral parting. Pyrite, and occasionally pyrrhotite and chalcopyrite, are constituents of these diabasic fragments and pebbles.

In addition to these pebbles and fragments of granitite and diabase others representing a greatly crushed and stretched feldspathic quartzite were noticed, containing also sericite and chlorite. Occasional fragments of a rock in which plagioclase and orthoclase are porphyritically developed in a fine-grained granular quartz-feldspar groundmass were also observed. Besides these composite pebbles there are very often fragments, usually sharply angular in outline, of both feldspar and quartz, which when present alone give the rock a decidedly porphyrite appearance. Some of these pseudo-phenocrysts embedded in a dark-green chlorite groundmass were examined, the rock thus constituted representing the 'country-rock' of Wright's mine on the east side of Lake Timiskaming. Some of these individuals proved to be feldspar, chiefly plagioclase, which have a broad tabular habit well striated and very turbid owing to somewhat advanced decomposition, while others are composite fragments of some porphyritic granitic rock with the large crystals of well striated plagioclase surrounded by finely granulated quartz.

As will be seen by a reference to the accompanying map sheets, this breccia-conglomerate is of very widespread occurrence in this district. On Lake Timiskaming it rises into hills nearly five hundred feet in height, in thick, almost structureless masses, although in large and well exposed sections lines which evidently represent original bedding may be distinguished. The total volume seen cannot be much less than six hundred feet, which perhaps represents the greatest thickness attained by this rock, although the conditions under which it must have been deposited were necessarily so unstable that at no place can the basement, upon which it originally rested, be detected. The present nature of its contact with rocks which may possibly represent refused portions of this original basement shows evidence of a considerable sinking down of the mass of clastic material into the molten or plastic magma beneath, so that it is manifestly impossible to state the true total thickness of what has been regarded as the basal member of the Huronian.

This breccia-conglomerate passes upward into a dark-greenish compact rock closely related in composition with the finer grained portion or matrix of the much coarser fragmental rock beneath. The transition upwards consists mostly in a gradual loss of the larger composite fragments.

Although in certain places an occasional pebble of reddish biotite-granite may be noticed, sections of this fine-grained and compact greywacké or feldspathic sandstone show an even-grained mixture of angular and subangular fragments, composed chiefly of quartz and orthoclase, together with, usually, a small portion of plagioclase. (Plate II., Fig. 3). Microcline though sometimes present is of rarer occurrence. These pebbles are embedded in a much finer groundmass relatively insignificant in quantity, originally feldspathic, but which is now composed of a confused aggregate of minute scales of yellowish-green sericite arising from its decomposition. A large amount of chlorite is present, usually disseminated in irregular shreds and fragments, although sometimes also forming part of the finer interstitial material, while the abundance of this mineral gives the prevailing greenish tint to the rock. Epidote and zoitite are also commonly abundant, and occasionally calcite, all these representing secondary products of alteration. Pyrite, magnetite and ilmenite are also very common constituents, the last mentioned mineral usually showin somewhat advanced alteration to leucoxene. Zircon, sphene, apatit and brownish dichroic tourmaline likewise occur, but are not by an means abundantly represented.

In ascending this rock gradually becomes finer grained, at th same time developing a marked slaty structure parallel to certai colour bands which represent original bedding. This slate, or slat greywacke as it may be called, (for in places large masses thou exhibiting the colour striping are altogether devoid of any structu except that produced by jointing), varies greatly in thickness, and occasional localities is not represented at all. The high hills fou on the northeast corner of High Rock island, as well as on the we side of Cross bay and Sandy inlet, show sections over a hundred feet in thickness, although in most cases the rock does not occur in such large volume. The colours occur in alternating bands showing a gradation from one to the other; usually of different shades of green with sometimes the addition of reddish-brown and black, thus producing a very beautiful striped rock. In some instances certain beds have been broken up, forming an autoclastic rock, which, when recemented, exhibits a beautiful mosaic of irregular though angular fragments. The constituents are essentially the same as described above, differing only in their finer state of division. The fragments as a rule show little or no evidence of water-action, being irregular and sharply angular in outline, in places forming an interlocking mosaic of quartz and feldspar grains, some of which have evidently originated *in situ*, while other portions suggest considerable recrystallization which has certainly taken place in some instances.

The structure in occasional instances is that of a microgranite, but usually the clastic origin is at once brought out by the microscope. The component fragments are remarkably uniform in size and closely compacted together, with little or no finer interstitial material, while the products of decomposition such as chlorite, epidote, sericite and leucoxene are partially scattered somewhat promiscuously through the rock in the form of irregular grains and scales, while many are arranged in a more or less definite manner in irregularly curving lines or areas.

The microscope reveals at once the nature and difference in composition of the colour-bands that so frequently characterize the rock. The lighter green bands show a prevalence of quartz together with a less proportion of feldspar, the latter being either fresh or showing only incipient sericitization, while chlorite and iron ore are only sparingly represented, if at all. The darker green bands, on the other hand, show a preponderance of feldspar, much of which has undergone somewhat extensive saussuritization, which, together with chlorite, gives the prevailing darker green shade to this portion of the rock. The dark, almost black, lines or stripings are seen to be composed of an infinite number of small crystals and opaque particles of magnetite, together with a much larger proportion of ilmenite, which, despite its extensive alteration to leucoxene, retains much of its original dark colour and opacity. The reddish-brown stripes are highly feldspathic in composition and owe their colour to abundant disseminated hydrated peroxide of iron. These slates evidently in most cases represent the consolidation of what must once have been extensive beds of volcanic mud or ashes. In certain instances, as on the eastern shores of Lady Evelyn lake and on Turner lake, they merge into coarser-grained irregular banded or foliated tufaceous rocks, which occur in immediate juxtaposition with large plutonic masses, while in other cases, as on the east shore of Lake Timiskaming to the north of Wright's mine, they are interbedded with coarse volcanic breccias or agglomerates made up of diabasic and quartz-feldspathic fragments embedded in a paste composed largely of chlorite.

In ascending this rock gradually becomes much coarser in grain, finally passing into a quartzo-feldspathic sandstone, although in certain places the latter rock was occasionally met with resting directly upon and merging downward into a basement composed of red granitite. This arkose is usually rather coarse in texture, in most places showing the characters of a grit, while certain bands or portions are conglomeratic. Many of the larger fragments in the conglomeratic phase of this rock represent very distinctly rounded or waterworn pebbles, the largest of which vary from an inch to two inches in diameter. These are composed for the most part of greyish-white, translucent, often much fractured quartz, and many of them are surrounded by a thin film of oxide of iron. Occasionally some pebbles of red quartz are present, and still more rarely others representing a 'stretched' feldspathic quartzite. Besides these there are greenish, greyish and pale-brownish, usually angular, or at most subangular, fragments of an extremely fine-grained rock, seemingly identical in composition to many of the chalcedonic-like fragments embedded in the vitrophyre tuff described by the late Prof. G. H. Williams from Onaping, Ont.* Besides these there are small, often angular fragments of red and yellow jasper together with smaller pieces of both reddish and greyish feldspar. These are embedded in a matrix composed largely of yellowish-green sericite, which, on account of its relative abundance, gives the prevailing tint to the whole rock. The rock, as has been stated, represents almost altogether the consolidation of true detrital material derived from the breaking down of granite, a portion of which is represented by exposures covering an area of nearly six square miles in the vicinity of the Old Fort narrows on Lake Timiskaming, although some of the embedded fragments are rather typical of volcanic ejectamenta: thus evidencing the continuance of the explosive activity, though with much diminished violence, which characterized the earlier portion of the Huron ian period. The nature and detailed description of the passage of th biotite-granite into this overlying arkose is fully discussed in th

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*Annual Report, Geol. Surv. Can., vol. V. (N.S.), Part I, 1890-91, p. 74
Sections Nos 35 and 42

geological description of the exposures encountered on the shores of the northern part of Lake Timiskaming.

The least altered form of this rock is a rather coarse arkose, which upon a superficial examination bears a remarkably close resemblance to an ordinary irruptive-granite. The constituent grains, mostly angular in outline, consist of quartz, orthoclase, plagioclase and microline, somewhat closely compacted together, with a very little intervening finer feldspathic material which is undergoing decomposition to kaolin and sericite. The reddish colour is imparted to the rock as a result of the abundance of ferric hydroxide which fills not only the minute fissures but also stains the larger feldspathic individuals. Other varieties which show no great degree of alteration or attrition and assortment through aqueous agencies are distinguished macroscopically by being brownish, pale-pinkish or greyish in colour.

A rather typical specimen of the prevailing greenish variety or 'sea green quartzite' as it has been called, obtained from a point on the east side of Lake Timiskaming (Boat-field point) about half a mile east of the Hudson's Bay Co.'s old post, shows the rock under the microscope to have originally been composed of feldspar and quartz. The quartz is in clear colourless fragments, sometimes with tolerably even outlines, but usually presenting very irregular ones, and the larger fragments are often made up of several interlocking grains. The feldspar which was originally present is now almost altogether converted into pale yellowish-green sericite which gives to the rock its prevailing colour. The sericite scales are usually exceedingly minute, but occasionally their presence can be detected macroscopically. There can be little doubt that much at least of the feldspar has been altered *in situ*. This alteration of the feldspar to sericite is shown in a beautiful manner in the section. It has left very irregularly shaped cores in the centre of the feldspar individuals. The field evidence shows in the most positive manner that the rock has had a clastic origin, but the materials, which must have originated in the immediate vicinity, show but slight evidence of having been waterworn.

At the very summit, in occasional localities, (as on the west side of the north arm of Nouwakaming lake, as well as near High pond on Maple mountain to the west of Lady Evelyn lake), this reddish or greenish arkose is overlain by thick massive beds of whitish or greyish-white quartzite. This rock is made up of angular or subangular fragments of ordinary granitic quartz filled with the usual inclusions, imbedded in a finer mosiac composed of quartz fragments together with sericite. It is often much shattered and sheared, the sericite present (and which is most abundant along the planes of pressure-cleavage) being the result of intense dynamic action on the feldspar originally present. This arkose, forming the topmost member of the Huronian in this district, varies greatly in thickness. In the vicinity of Lake Timiskaming hills composed of approximately horizontal strata of this rock rise to a height of five hundred feet above the lake, while to the west of Lady Evelyn lake and forming the bulk of Maple mountain the total thickness represented is nearly eleven hundred feet.

The greatest total thickness attained by the Huronian formation in this district is nearly eighteen hundred feet, made up roughly a follows:—(1.) Breccia-conglomerate 600 feet. (2.) Slates and slaty greywackés 100 feet. (3.) Quartzite grit or arkose 1,100 feet.

Diabase and Gabbro.

Massive rocks of both the diabasic and gabbro types are frequently and intimately associated with both the epiclastic and pyroclastic rocks of the Huronian. Such rocks have often, in fact, been included as part of the Huronian system, although they appear indeed to be practically contemporaneous in origin in many cases, but they should not be counted as a part of the system when its thickness is to be ascertained. These basic intrusives apparently represent the deeper seated plutonic action connected with the volcanic outbursts that gave rise to the ejectamenta which are so abundantly represented.

Many of the masses of this kind are intimately associated with, and merge gradually into, a rather typical flesh-red biotite-granite or granitite, while several of the exposures are pierced and traversed by irregular dike-like forms and masses of pegmatitic material. This gradual passage into granitite can be directly and continuously traced in a number of instances in single outcrops. The most reasonable assumption is that all three rock-species, diabase, gabbro and granitite, represent highly differentiated portions of the same magma which have solidified at temperatures corresponding with their composition.

These basic plutonic rocks characterize large areas, occurring for the most part as a series of irregular, though often somewhat rounded batholithic masses, which send off large arms or dikes to intersect the neighbouring stratified rocks. In certain localities, as on the southwest side of Round lake (Wawiagama) a little beyond the western limit of the Lake Timiskaming sheet, as well as at Beaver mountain, south of the mouth of the Montreal river, they appear to represent the consolidation of what may possibly have been intruded sheets or sills of molten material. This, however, could not be positively ascertained, as the covering of clastic rocks, if originally present, has been removed by subsequent denudation.

These rocks, in the area here considered, usually possess a medium texture, although in many instances they are so coarsely crystalline that most of the principal constituents are plainly apparent. In general they vary from greenish-grey through dark-green to almost black in colour, although in many of the coarser phases the prevalence of feldspar with a distinct flesh-red colour gives a prevailing reddish tint to the whole mass. In most places they have a massive much jointed character, and this, together with the extensive shearing action to which these rocks have been subjected, makes it exceedingly difficult to secure even a hand specimen of well shaped outline. In occasional localities, as at Manitou rock on the west side of Lake Timiskaming, the rock shows a rude columnar or basaltic structure.

Under the microscope these rocks present a remarkably uniform mineralogical composition in the several separated masses, while the specimens obtained almost invariably exhibit, in a very typical manner, the ophitic structure which belongs essentially to diabase, although in some other areas, as well as in certain portions of the same mass, it sometimes shows the holocrystalline or granitoid structure of gabbro.

The least altered variety of the rocks of this class is made up essentially, and almost wholly of plagioclase and augite, the former mineral being present in the usual idiomorphic lath-shaped individuals penetrating the allotriomorphic augite. From the extinction-angles the plagioclase is near the basic end of the series—labradorite and bytownite. The mineral is sometimes rather fresh and glassy, although frequently it shews a marked turbidity, owing to the development in it of the usual saussuritic products of decomposition, while the aguite, which when fresh is of a distinct reddish-brown colour, is as a rule partially decomposed to green trichroic hornblende. A few rather broad tabular unstriated individuals of feldspar are usually present, and may possibly represent orthoclase. Reddish-brown, strongly pleochroic boitite is found in irregular plates, but not in any excessive amount. Quartz is likewise a rather constant constituent, occurring in small clear irregular areas filling in the lesser interspaces between the feldspar and augite. The ilmenite present very often shows the characteristic 'gridiron' alteration to lucoxene. In certain instances, as at Quinn point on the east side of Lake Timiskaming, the rock has undergone considerable decomposition, the augite being completely altered to green trichroic hornblende (uralite.)

Most of this uralite is the usual compact dark-green variety, but some of it has assumed the actinolitic habit. In other localities, as on the Quinze river, the diabase has undergone still more advanced alteration, the whole rock-mass being converted into a rather typical hornblende-schist or amphibolite as a result of intense pressure. Traces of an ophitic structure still remain, showing clearly the original character of the rock, although in places this is masked by the extreme deformation to which the rock has been subjected. The process of the uralitization and decomposition of the augite is very interesting and instructive, showing first an alteration to the compact green trichroic variety of hornblende, the individuals presenting deep-coloured borders with pale interiors. This, with an increase in deformation, assumes the fibrous or actinolitic habit, which, in turn, is decomposed to chlorite, the individuals of the last-mentioned mineral retaining much of the marked pleochroism of the hornblende. Some of the plagioclase seems remarkably fresh, although the greater proportion is altered to opaque greyish masses of saussurite, the resulting epidote, zoisite and sericite being especially abundant in those portions of the rock which have yielded most to pressure. The ilmenite originally present is often almost wholly converted to a brownish sphene, which occurs in grains or aggregates scattered through the rock.

A section prepared from a specimen representative of a small mass of highly altered gabbro that protrudes through the breccia-conglomerates and slaty greywacké on the east shore of the southwest arm of Lake Timagami shows that the rock is now composed of feldspar, quartz, pale-green fibrous chlorite, biotite and zoisite. The mutual reaction of the feldspathic and ferro-magnesian constituents has been so pronounced, and the resulting decomposition products have in many cases wandered so far from their former positions, that the original structure is to a certain extent masked. Zoisite is a very abundant constituent of the rock as an alteration product, occurring in irregular grains and crystals. Sphene is also quite abundant and has resulted from the decomposition of ilmenite originally present. Small cores of the unaltered ilmenite still remain. The biotite is of a pale-brownish colour as a result of the leaching out of a portion of its iron.

The rock composing the upper and more precipitous portion of Beaver mountain, or the 'King of the Beavers' as it is sometimes designated, is a dark greenish-grey diabase, in which the ophitic structure is visible to the naked eye. It is much sheared and broken, the planes of cleavage and jointing being plentifully coated with dark-greenish minerals belonging to the chlorite group. Under the microscope the rock is seen to be composed mainly of plagioclase and augite. The plagioclase, which from the extinction-angles is near the basic end of the series (probably bytownite), is usually pretty fresh, but some of the individuals are rather turbid, owing to the presence of decomposition products, while considerable areas are characterized by the presence of light-greenish sericite and yellowish-green epidote and zoisite resulting from the saussuritization of the feldspar substance. The augite is as a rule fresh and occurs in allotromorphic masses pierced by the laths of plagioclase. It is reddish-brown in transmitted light, a variety frequently met with in diabases, and many of the individuals are characterized by the presence of innumerable rod-like interpositions (schillerization products.) Frequently it is noticed undergoing incipient alteration to compact pale-green trichroic hornblende. A considerable quantity of reddish-brown biotite is present in irregular plates and scales. A little quartz was also noticed, while both pyrite and an opaque iron ore, probably ilmenite, are present, scattered in irregular grains throughout the section. Besides these comparatively large and irregular areas may be seen composed of a pale yellowish-green serpentinous substance, associated with secondary calcite and often dotted with strongly refracting grains and elongated fragments of epidote, the whole showing aggregate polarization. Very often these irregular masses show the characteristic net-like structure so common in serpentine derived from the decomposition of olivine, although the small residual cores still remaining in some cases have a lower double refraction than is usual in this mineral.

Besides the masses above referred to, which are so intimately associated with the clastics of the Huronian, there are also similar basic intrusives incorporated with the Laurentian gneisses and granites, which clearly do not belong to the same magma from which these latter rocks have been produced. In most cases these appear to be of earlier generation than those associated with the Huronian, although no very positive statement can be made on this point. The gneiss in immediate conjunction is often more basic and hornblendic, seemingly showing a commingling by actual fusion of the two rocks along their line of junction.

Outcrops of a uralitic diabase marking the occurrence of a small [illegible] of this rock were noticed apparently cutting and altering the granitite-gneiss exposed on the northwest shore of Expectation lake near the southwest end. The diabase is much finer grained near the junction with the gneiss. The specimen obtained showed the rock to be a medium-grained, dark-green, basic eruptive, the diabasic structure of which can be seen in the hand specimens. The microscope shows it to be a remarkably good instance of a diabase in which the bisilicates have been almost entirely decomposed, while the plagioclase remains in a comparatively fresh, unaltered condition. The minerals now present are plagioclase, hornblende and chlorite (doubtless representing augite originally present), ilmenite accompanied by leucoxene, apatite and sericite. A few of the plates of chlorite look as if they may have been derived from biotite. The plagioclase is in rather broad lath-shaped ctions which interlace, giving a coarse ophitic structure to the rock. It is well striated (both albite and pericline laws being represented) possesses very uneven extinction and has evidently been subjected to a considerable degree of pressure, many of the crystals being shattered. The augite originally present is now almost entirely altered to a pale yellowish-green chlorite. It has evidently passed through n intermediate stage of alteration to hornblende, as that mineral, of a pale bluish-green colour and fibrous, in which the alteration to chlorite is so far advanced as to almost entirely obliterate the optical character of the hornblende, surrounds lighter, still more altered cores which doubtless represent the original augite. Magnetite resulting from the decomposition of the bisilicates, a little apatite, sericite and epidote occur as secondary products.

This diabase is in contact with a dark-green, fine-grained, compact, foliated rock, sprinkled with little crystals of pyrite. Under the microscope the ground-mass consists of a fine-grained mosaic of clear quartz and feldspar, through which run little strings of a brown biotite in fine brightly polarizing scales which are evidently of a secondary origin, and in places show an alteration to chlorite. Throughout this fine-grained material larger grains of quartz an feldspar (principally microcline) are distributed, which by thei granulated appearance and very uneven extinction bear unmistak able evidence of the dynamic action to which the rock has been sub jected. Large irregular grains of pleochroic epidote, colourless t pale yellow, frequently showing good cleavage, are abundant, as ar also large clove-brown crystals of sphene. Crystals of zircon, fairl large, and frequently showing marked zonal structure, are plentifu Some pyrite and iron ore were also observed.

Another mass of these basic eruptives that may be mentioned this connexion is well exposed on the shores of McDiarmid lake, th southern part of Breadalbane lake and the islands and points chief in the central portion of Fanny lake.

The rock is dark-green, almost black in colour, weathering rus or brownish owing to the oxidation of the large amount of pyri finely disseminated through it. Atmospheric agencies have likewi produced a rough, though somewhat finely pitted surface, owing the decomposition and removal chiefly of the coloured constitue leaving a reticulated surface formed by the feldspar standing out relief. The relations with the surrounding gneissic rocks of the Laurentian series seem to show its earlier genesis, and these foliated and much more acid rocks are rendered relatively more basic or hornblendic in the immediate vicinity of the line of junction, apparently as a result of the free interchange through actual fusion of the material of both rocks. The basic rock has usually a rather well marked foliation, which corresponds in general with the strike of the enclosing gneissic rocks. On McDiarmid lake this strike is S. 24° E., the rock being nearly if not quite vertical, while on Fanny lake the strike is N. 35° E. with a dip to the northwest of 85°.

Under the microscope this rock is seen to be a rather fresh diabase composed chiefly of plagioclase and augite. The plagioclase is unusually fresh and glassy and well striated with albite and pericline laws being represented. It occurs for the most part in rather broad, lath-shaped crystals penetrating the irregular individuals of augite. As a result of pressure it usually exhibits a wavy extinction, is sometimes bent or curved and occasionally fractured and dislocated. The augite is of the reddish colour so often noticed in diabase and occurs in irregular polysomatic areas.* These composite individuals or masses are surrounded by a narrow rim of remarkably uniform width, composed of fibrous and radiating scales of pale-greenish chlorite, each separate scale being approximately at right angles to the outline of the unaltered portion. (See plate II., fig. 1.)

The augite is rather fresh, while the line of division between these 'reaction-rims' and the unaltered portion of the individual is very sharp and abrupt. Associated with the augite and frequently completely enclosed by it are irregular plates and scales of a reddish-brown strongly pleochroic biotite. Sometimes it is considerably bleached while occasionally it is altered to chlorite.

On the west side of Lake Timiskaming, nearly opposite Latours Mills, black, irregular, roughly weathering masses of a very basic rock may be noticed caught up in and penetrated by the associated granitite-gneisses mapped as Laurentian.

The hand-specimen examined is black in colour with glistening scales of mica abundantly developed through the mass. The weathered surface is rough and pitted, resembling a pumice-stone. Under the microscope the component minerals are seen to be hornblende, biotite plagioclase, garnet and iron ore. The hornblende is green in colour, trichroic, and occurs in large areas composed of an aggregate of small individuals. Occasionally these aggregates show a pale interior with a dark-green border surrounding the masses. It is undoubtedly secondary in origin and some of it is actinolitic, and is the most abundant mineral in the section. The biotite is rather pale in colour owing to the removal of a part of the iron, and frequently shows pleochroic halos surrounding embedded fragments of the other constituents of the rock. The plagioclase is not nearly so abundant, and is very frequently almost opaque from the inclusion of dark-brownish dust-like particles. The garnet is in irregular grains as is also the iron ore, which is probably magnetite. A somewhat rude ophitic structure can still be detected in the rock.

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*Annual Report Geol. Surv. Can., vol. III. (N.S.). 1887-88. p. 155 F.

Besides the foliated diorites that occur as integral and extremely basic portion of the prevailing Laurentian gneisses there are occasional and comparatively large irregular areas of massive diorite, which are apparently of earlier genesis than the foliated rocks with which they are associated. One of the largest of these masses noticed occurs on the southern mountains to the southwest of the west point of Maskinonge island, on Bear bay in Lake Nipissing. The mass has, roughly speaking, a diameter of a little over four hundred feet. A border of black mica-schist (probably a mica-diorite-gneiss) nearly three feet in width separates this massive basic rock from the gneiss, the foliation of the diorite gneiss curving round the outline of the mass. The whole mass is penetrated by reddish quartzo-feldspathic masses of dikes which are evidently extremely acidic portions of the same magma from which the gneisses have solidified. Fragments of the basic hornblendic rock are embedded in gneisses near the line of junction.

Under the microscope this rock is seen to be a [illegible] granite, being composed of plagioclase, orthoclase, quartz, hornblend an orthorhombic pyroxene and garnet with smaller quantities o sphene and iron ore. It possesses a holocrystalline structure an shows only slight evidences of pressure in the uneven extinction the quartz and feldspar individuals. The feldspars as a rule ar quite fresh. The hornblende is usually in massive irregular ind viduals of a green colour and strongly pleochroic. Occasional dividuals show good crystallographic outline. Excellent examples the micropoikilitic structure described by Dr. G. H. Williams* we observed. Thus certain areas of the rock are occupied by compar tively large individuals of hornblende which are crowded with irr ular grains of quartz arranged without any reference to one anoth or to the matrix, and, which neither possess the complete indepen ence of optical or orientation characteristic of granular structure n the entire continuity of the separated portions of two interpenetra ing crystal individuals.

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*Journal of Geology, Chicago, vol. I., No. 2.

The orthorhombic pyroxene, which is probably hypersthene, has a parallel extinction, is rather light in colour and has a feeble pleochroism, with light-yellowish to pale reddish tints. It is somewhat abundant and occurs in individuals having irregular outlines. The garnet is usually in large individuals full of irregular cracks. It is pale ruby-red in colour with characteristic high relief. The [illegible] is in irregular grains frequently imbedded in the hornblende. An opaque iron ore is rather abundant in the section examined.

GRANITE

The rock to which this general name has been applied is, for the most part, a biotite-granite or granitite according to Rosenbusch's classification. As the details of the numerous exposures of this rock are to be found in connexion with the geological description of the lakes forming the series of canoe-routes which afford an access to or across these masses, it will only be necessary, in this connexion, to give a very general notice of this rock, applicable alike to most of these separate occurrences. It is of a prevailing reddish colour, rather coarsely crystalline, the principal constituents being usually readily distinguishable with the unaided eye. In some localities it presents a very massive structure, while occasionally it shows a very distinct foliated texture. In several cases, notably in the [illegible]ing Spawning and Young Loon bays of Lake Timagami, occurrences of this rock present a very coarse, often porphyritic variety, the phenocrysts being Carlsbad twins of orthoclase developed in a quartz-feldspathic ground-mass rather poor in ferro-magnesian material. Orthoclase is the most abundant feldspathic constituent, although microcline and plagioclase are both present in considerable quantity, while quartz, which is as a rule proportionately less in amount than the feldspar, is of the prevailing granitic variety full of glass and other inclusions. The coloured constituent is generally biotite which has either partially or wholly been decomposed to a pale-greenish chlorite, the individuals preserving much of the original marked pleochroism of the minerals from which it has been derived. Epidote and sphene are both very abundant and frequently in such large crystals and fragments as to be macroscopically discernible.

In the midst of all the large granite areas considerable tracts are characterized by greenstone, while masses of this greenstone (diabase and gabbro) are frequently so intimately associated with the granite that separation, especially on the scale adopted on the accompanying maps, would be impossible. Dikes and masses of granite and pegmatite likewise accompany outcrops marking the large occurrences of diabase and gabbro. Although in most cases a marked and sharp contrast exists between the two types of rocks (acidic and basic), it was rather definitely ascertained that the rocks are very intimately related, and it seems quite evident that the dates of their respective intrusions are nearly synchronous, the basic types representing the first segregations of a magma which ultimately crystallized as granitite and granitite-pegmatite. On the other hand these areas of massive granitite merge into foliated granites of gneisses which are usually indistinguishable from, and sometimes co-extensive with, similar material described and mapped as Laurentian.

POST-ARCHÆAN ERUPTIVES.

Besides the huge masses of diabase and gabbro that are so intimately associated with the Laurentian and Huronian, most of which seems to be practically contemporaneous with these rocks, there are other intrusives occurring principally in the form of dikes which cut the Laurentian gneisses, and are thus very obviously of later origin. The greater number of these occurrences possess sharply defined and approximately parallel enclosing walls, although some have filled irregular cavities of the pre-existing rocks, and thus possess more ill-defined contours.

The first of these which may be mentioned was noticed on the east side of the Ottawa river between Les Erables rapids and Snake creek, the intrusive masses apparently piercing the associated granitite-gneisses. Macroscopically the specimen examined shows a very coarse-grained dark-grey rock, with a reddish tinge given by the abundant presence of a wine-coloured almandine garnet. Under the microscope the rock is evidently a very typical example of crushed and epigenized gabbro. The minerals noticed as present in the microscopic section are plagioclase, unstriated feldspar (possibly orthoclase), quartz, diallage hornblende, biotite, garnet, apatite, iron ore, pyrite, together with serpentine chlorite occurring as secondary products of decomposition. The plagioclase, which is by far th most abundant feldspar present, is much disturbed, bent and occasionally broken, while many of the surviving large individuals show in a very beautiful manner the uneven or undulous extinction due t pressure. Much of this mineral is quite fresh and glassy, although many irregular and often large spaces in the crystals are very turbid owing to the abundant development of exceedingly numerous an minute scales of sericite and kaolin; these products of decompositi sometimes arranging themselves in plumose aggregates. The di lage, when free from impurities, show a rather faint, though p fectly distinct pleochroism, from light-greenish to pale-reddish. Many of the larger individuals are rendered almost isotropic by the interposition, along the planes of parting, of an almost infinite number of minute brownish, more or less opaque, particles. All stages in the development of these schillerization products may be noticed, from individuals that are entirely free from such impurities to others which are perfectly crowded with them. Some of the diallage shows somewhat advanced decomposition to serpentine. The brownish-green trichroic hornblende present occurs for the most part in the form of 'reaction rims,' surrounding and resulting from the alteration of the diallage. The wine-coloured garnets, which, together with the colouring of the diallage, have been developed by the percolation of heated water (epigenetic action), occur in small crystals and crystalline fragments, often forming an irregular zonal area surrounding the bisilicate material. The biotite, which is present in comparatively small quantity, is of a deep reddish-brown colour and strongly pleochroic.

On Iron island, in Lake Nipissing, the prevailing gneiss is intersected by huge irregular masses of a dark brownish-grey highly micaceous trap. The specimens secured as illustrative of one of these occurrences near the southwest point of the island show the rock to vary considerably in texture, some portions being fine-grained with a distinct approach to porphyritic structure, the biotite occurring in crystals with sharply defined hexagonal outlines; other specimens are much coarser grained, with the biotite in broad irregular flakes, and lacking the distinct porphyritic appearance of the fine-grained material. The rock weathers to a rusty brown colour, is greatly decomposed and filled with carbonates, causing it to effervesce freely with acid. The microscope shows that the principal minerals now present are biotite and garnet, with abundant iron ore, some accessory augite, a little hornblende (?) and masses of calcite, etc., which may represent in part feldspar originally present, though none are now observable. Apatite is abundant in good-sized long prismatic crystals. The section of the finer-grained portion contained no garnet, while in the coarse-grained phase of the rock this mineral is exceedingly abundant. The garnet is of a peculiar yellowish-brown colour and resembles the melanite variety, while the coarse portion of the rock might be described as composed essentially of biotite and melanite garnet with some little accessory augite and perhaps hornblende. The rock is a most remarkable one and further investigation on fresher material might prove it to be a hitherto unobserved member of the mica-peridotite family.

Another interesting and rather rare species of dike-rock was noticed on the most southerly of the Manitou islands in Lake Nipissing. Near the southern extremity of this small island dikes. as well as irregular masses of an alnoite-rock, cut the dark reddish and greenish granitite-gneiss representing the Laurentian. One of these dikes is about ten feet in width, running in a direction nearly east-and-west and intersecting the foliation of the gneiss almost at right angles.

Another occurrence showed a fissure about six inches in width filled with the same material. Murray* mentions the occurrence of intrusive masses of the same rock as seen on one of the islands in East bay opposite Callander station. The specimens of this rock consist of a fine-grained greenish groundmass in which are embedded large phenocrysts of biotite and augite, together with rounded greenish masses, which at first sight seem to resemble concretionary or pebble-like inclusions. On examination these simulate rude prismatic crystals, but only the skeleton forms remain, filled with decomposition products, chiefly calcite, and that may possibly represent olivine, originally present. In the hand-specimens the large plate of biotite and phenocrysts of augite are especially noticeable, at onc suggesting its probable close affinity to the alnoite first described b Törnebohm†, in 1882, from the island of Alnö in Norway. The thi section, under the microscope, shows an exceedingly fine-grained and decomposed groundmass consisting of an intricate mixture of brightl polarizing scales of bleached biotite, chlorite spicules and crystal of hornblende (actinolite), calcite, pyrite, iron ore and leucoxene, i which are embedded larger individuals of augite and biotite, th former almost wholly converted to hornblende and calcite, althoug the characteristic skeleton forms remain. In this matrix are deve oped large though somewhat rude phenocrysts of biotite and augit The large individuals of augite show a perceptible, though somewh indistinct, pleochroism and are traversed with a network of crac more or less filled with hornblende and calcite, products of its alte ation and decomposition. They are as a rule surrounded by a ri of variable width composed of the usual hornblende (uralite), show ing beautiful deep-bluish polarization colour between crossed nico The biotite is rather fresh, although some of the iron has been moved, and, as a consequence, exhibit brilliant chromatic polar ation colour. The pleochroism is strong, from deep brownish-red pale-yellow. The individuals have a hepidiomorphic outline, occ ing in elongated plates and scales which show considerable opt disturbance as a result of pressure. The rock doubtless belongs to the group which includes the alnoites, monchiquites and fourchites but it is now so decomposed that its exact position cannot be determined. Closely related rocks have been described by C. H. Smyth, jr.,* from Central New York, and by Adams,† from Ste. Anne de Bellevue, Quebec, and from a point on the road between Ashcroft and Savona, British Columbia, three miles east of Eight-mile creek.

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*Report of Progress, Geol. Surv. Can., 1853-56, p. 122.

†A. E. Törnebohm: Melilit basalt frin Alnö, Geol. Forn. i Stolkholm F 1882, p. 240

About five chains north of the last occurrence of this rock, on the west side of the same small island, beds of pink crystalline limestone occur containing more or less epidote, biotite and hornblende as impurities. The strike of the rock is about N. 80° E., while the dip is at an angle of 65°. A dike varying in width from nine and a half to eleven inches, of fine-grained, dark-greenish, almost black rock was noticed intersecting this limestone in a direction N. 4° W.

Under the microscope the rock is seen to be greatly altered, consisting chiefly of microcline and hornblende, the latter evidently secondary in origin. The original rock, unaltered, was probably an augite-microcline one and thus allied to the vogesites. The hornblende occurs in elongated pale yellowish-green individuals considerably altered to chlorite and frequently forming sheaf-like bundles of crystals. A close study of the section reveals numerous examples of comparatively unaltered cores of the original augite. The feldspar of the rock giving generally elongated sections appears to be principally microcline, although some plagioclase was also observed. It is turbid, being full of inclusions of hornblende, sericite, etc. Brilliantly polarizing secondary epidote is abundantly distributed throughout the rock.

On one of the smaller of the Goose islands, at the extreme west end of the group, the pinkish granite-gneiss strikes N. 70° E., with a dip to the south < 50°. Near the northwest end a greenish dike of fine-grained material about one and a quarter feet in width cuts across the whole end of the island running in a direction N. 58° E.

About three miles and a half northeast of Bonfield station (formerly Callander) a rock-cutting made during the construction of the Canadian Pacific railway shows a good section of a massive granitoid gneiss pierced by several dikes of a rusty-weathering medium-textured diabase. The rock has a marked concretionary structure, which is revealed as a result of ordinary weathering, the successive thin concentric layers of rock peeling off much like the coats of an onion. The dikes cut across the indistinct foliation of the associated

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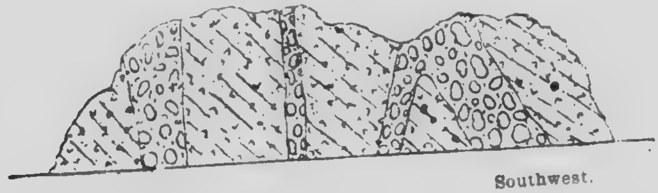
*American Journal of Science, April, 1892, August, 1893, and October, 1896.

†Ibid., April, 1882; also Annual Report, Geol. Surv. Can., vol. VII. (N S.), p. 388 B, No. 79 A.

gneissic rocks. Near the walls the dikes are very much decomposed
and schistose, while the gneiss is baked and altered to a slight degree
in the immediate vicinity. The largest of the dikes, near the south-
west end of the cut, is six feet across with a branching arm about two

Fig. 2.



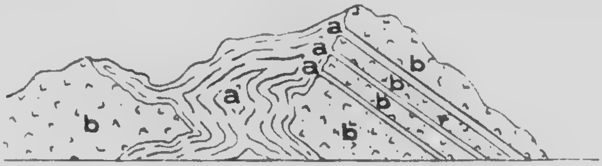
DIKES OF CONCRETIONARY DIABASE 3½ MILES N. E. OF BONFIELD.

feet in width. Another dike near the northeast end of the outcrop
is four feet in width, while the third is only about one foot in width.
The rock composing these intrusions is readily attacked by atmos-
pheric agencies and is more or less hollowed out in the adjacent hard
gneiss. Dikes and masses of precisely similar material are exposed
along the line of railway between Sudbury and the Murray mine,
which in a thin section under the microscope is found to be a rather
typical and fresh olivine-diabase. No petrographical examinati
was, however, made of the rock from the locality above described, as
the specimens secured were lost in transit.

Along the line of the northern division of the Grand Trunk rail-
way, in the vicinity of Callander station to the east of Lake Nipis-
ing, the various rock-cuttings show good exposures of a massive gran-
itite-gneiss. As a rule, this is a medium-grained distinctly foliated
granitic rock, in which the dark-coloured irregular strings and layers
composed of the ferromagnesian constituents, (principally biotite),
alternate with broader reddish bands of coarse-grained feldspar and
quartz, in which lie little patches and strings of the darker material.
Frequently the gneiss has a very distinct augen structure, the lenti-
cles composed almost wholly of reddish feldspar being sometimes as
much as six inches in length by two or three in breadth. The stri
of the rock varies from N. 20° W. to N. 20° E. with a prevailing
to the east at a high angle, usually over 60°. In some instances the
rock is quite massive, showing little or no evidence of foliation.
These reddish granitoid rocks are intersected in several places, al
at right angles to the foliation, by irregular often branching dikes
of comparatively fine-grained dark greenish-grey, sometimes alm

black, rocks. In the immediate vicinity of the line of contact the gneiss exhibits a narrow selvage of much finer grained rock showing the intrusive action of the dike, while in some instances fragments of the gneiss have been caught up and incorporated in the body of the dike. At the first cutting, about a quarter of a mile south of Callander, the rock is very massive and granitoid, but at the second a well marked foliation has been developed, running N. 10° W. with an easterly dip at a high angle. This rock is intersected by two dikes, dark-green to almost black in colour, containing porphyritically embedded individuals of a black, bright, glistening mineral. The walls of the dikes are more or less irregular, often serrated and frequently presenting re-entering angles of fine-grained material which penetrates the mass of the neighbouring granitic rock. At the widest places the larger of the two dikes is about seven feet thick, while the smaller is about two feet. The dike interrupts the foliation of the gneiss and near the contact both rocks are much finer in texture, while fragments of the gneiss are embedded in the dark-greenish rock. Under the microscope the rock possesses a peculiar irregular granular structure, and the intergrowth of hornblende and feldspar gives to the section a pseudo-granophyric appearance. The section is filled with a dense mass of little shreds of hornblende in a groundmass composed chiefly of broad plates of orthoclase. There are numerous large phenocrysts having centres composed of a pale-green diopsede-like pyroxene, altered on the outside to a green hornblende. Biotite is also plentiful in large fresh irregular plates full of inclusions. Titanite and apatite also occur. The whole section is sprinkled with iron ore, pyrite and granules of epidote. It is a very basic rock, near the syenite end of the peridotites and between these and the vogesites. It might be termed a hornblende-augite-minette.

Fig. 3.



West side of cutting, one mile south of Callander, G.T.R.

SKETCH SHOWING DIKE-LIKE FORMS OF MICA-PHONOLITE (a) CUTTING GRANITE-GNEISS (b).

The next cutting, situated about a mile south of Callander, runs through a hill of a deep-reddish granitite-gneiss. At the north end of the cutting the foliation is quite distinct, this structural feature striking about N. 10° E. with an easterly dip $< 60^\circ$, but towards the middle of the cutting the rock is very massive, showing only indistinct foliation. This rock is pierced by irregular dike-like forms of a massive, dark, greenish-grey rock, which shows a marked difference in texture, being fine-grained near the containing walls of the dike and coarser toward the middle. There is a selvage of about an inch of fine-grained granitite near the contact with the darker rock. In some places these dikes have comparatively regular and straight walls, while in others they are of somewhat irregular outline. On the west side of the track near the north end three of the narrower dikes, in approximately parallel position, cut the granitite and are connected with the larger and more irregular body of the dike. The whole section exposed is a little over a hundred feet in length. The finer grained portion of the dike near the walls, shows a very compact dark-green slaty rock filled with a multitude of joints, causing the rock to break into a large number of small, irregular rhombohedral fragments. Under the microscope it is seen to be much altered and very fine-grained. It is composed of a groundmass made up of a colourless isotropic substance, sprinkled all through with irregular patches and spots (micropoikilitic) of a mineral with higher refraction and very high double refraction which may be calcite, also occasional laths of a low double refractive mineral suggesting feldspar. The section is also spotted with minute scales of green biotite. Augite, some of which is fresh, is present; but one phenocryst with inclusions of feldspar was noticed decomposed to a serpentinous product. Considerable quantities of titanite, some ilmenite, leucoxene, pyrite, apatite, zircon, fluorite and lepidomelane are also present. The section represents an alkali rock, and is probabl allied to the mica-phonolites.

Other dikes than these above described are also occasionally met with, but they have not been examined petrographically.

CAMBRO-SILURIAN.

The transgression of the sea far up the valley of the Ottawa during early Palæozonic times has long been a well ascertained fact, and the character, thickness and fossil remains of the numerous and extensive Palæozoic outliers have been described. The marine invasion began with the shallow-water conditions indicated by the deposition of the conglomerate and sandstones of the Potsdam, and ended—so far as evidence is afforded by the exposures of strata below Mattawa—with the Utica. This submergence must have been gradual and of great duration, the ocean reaching its greatest depth and extent in this area about the close of the Trenton period, when a comparatively rapid re-elevation of the land took place, as indicated in part by the deposition of the Utica shale, and ending with the final emergence of the whole area to conditions of dry land.

It seems probable that the depression at present occupied by the Ottawa river, which in past geological time was of much greater extent and importance, formed, during the deposition of the Cambro-Silurian, a large gulf or arm of the sea, with transverse bays or inlets extending far into the interior of the Archæan plateau of central Ontario along depressions which even then existed, and which are now occupied by the more important tributaries of the Ottawa. This arm of the sea certainly extended as far up the Ottawa as the Mattawa, and small exposures of arenaceous limestones which have escaped the forces of denudation occur at intervals in the immediate valley of the river between Pembroke and Mattawa. The comparatively deep-water conditions indicated by the deposition of these limestones, which were certainly of much greater extent and volume than at present appearing, furnishes strong presumptive evidence for believing that the sea was continuous in the form of a strait through the valley of the Mattawa river, thus connecting directly with the vast interior basin of western Ontario in which strata of similar age and character were being deposited. The Cambro-Silurian known to occur on the Manitou and Iron islands in Lake Nipissing are doubtless outliers of the belts of rocks of the same age which outcrop farther to the west and southwest.

To the north, up the main valley of the Ottawa, it is perhaps likely that the sea extended as far as the head of Lake Timiskaming and a short distance beyond, and that strata then deposited lie concealed beneath the Niagara limestones that outcrop on the shores and islands of the northern part of this lake. This seems the most satisfactory explanation that can be offered at the present time to account for the presence of numerous, often large and angular, fragments of Cambro-Silurian strata with embedded characteristic fossils that are found lying loose at intervals along the shores of the northern part of the lake, and which certainly afford no evidence of having travelled any great distance from their source.

Chazy, Birdseye and Black River Formations.

On the west side of Iron island, in Lake Nipissing, beds of chocolate-brown and yellowish-grey, coarse sandstone or grit, occasionally becoming a fine conglomerate, rest unconformably on the upturned edges of the gneissic rocks classified as Laurentian. The rock is composed of loosely compacted and rounded grains of quartz more or less abundantly coated with hydrous oxide of iron with little or no interstitial material. The lowest beds are of a brown colour, with occasional lighter spots from which the iron oxide has been removed, while higher beds are yellowish-grey, also showing lighter coloured areas. When subjected to the action of the weather curious subspherical rings suggestive of concretionary action appear on the exposed surface, but a close inspection shows no apparent difference either in composition or texture of the part where these are developed. The beds are of good thickness, but would be useless for building purposes on account of the loose and friable nature of the sandstone. Little or no calcareous matter is present, which is a rather unusual feature, as even the coarse arkose or conglomerate lying at the base of the Manitou Islands outliers contains a considerable admixture of carbonate of lime. Murray* mentions the finding of loose fragments of limestone, with characteristic Chazy fossils, that possibly overlie these sandstones, which may thus represent the basal portion of the Chazy formation.

The Manitou islands, five in number, are situated about the middle of the wide open space in the eastern part of the lake. The largest and most northerly of these islands is about a mile in length from east to west, and is known as the Great Manitou or Newmans island. The next in size and importance is the Little Manitou or McDonalds island, while the other three are so small and insignificant that they have not been separately named.

The most southerly of these islands is somewhat less than a quarter of a mile long, but only a few chains in width. On the southeast side of the island is a dark-brown arenaceous limestone, containing angular or subangular fragments and pebbles of the subjacent gneiss. This rock is of no great thickness, and passes rapidly upward into a yellowish-grey arenaceous limestone. The whole section exposed is of small extent and thickness, the beds lying in nearly, if not quite, horizontal succession. The shore is strewn with large angular blocks of the coarse-grained, yellowish-grey, arenaceous limestone, containing many weathered and waterworn fragments of obscure cephalopod-like remains. These fragments, according to Dr. H. M. Ami, who has examined them, resemble the *Eudoceras multitubulatum* (Hall) from the Trenton and Black river.

McDonalds island, or the Little Manitou, is about half a mile in length from north to south and of no great breadth. At the south-west corner is a small patch of yellowish-grey limestone, occurring in beds which have little or no inclination. The only fossil remains visible at this locality were fragments representing chiefly the siphuncles of orthoceratites, together with crinoid stems and casts of supposed worm-burrows. Small outlying patches were also noticed beneath the surface of the water.

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*Report of Progress, Geol. Surv. Can., 1853-56, p. 125.

About the middle of the island, on the west shore, the thickest exposure of the whole of these outliers is exposed. The total thickness is about thirty feet, the beds showing a gentle inclination to the west. At the base is a greenish or yellowish arenaceous limestone holding decomposed fragments and pebbles of the gneissic rocks beneath. This is overlain by a yellowish, arenaceous limestone, comparatively free from coarse fragmental material, which in turn gradually passes upward into grey limestones and shales holding numerous fossil remains. The orthoceratites are characteristic and numerous, and one specimen obtained must have belonged to an individual over six feet in length.

The following lists of fossils have been prepared by Dr. H. M. Ami from collections made by myself and my assistant, Mr. A. M. Campbell:—

Palæophyllum or ***Columnaria***, imperfectly preserved.
Amplexopora, sp.
Coscinopora (?) sp.
Monotrypella quadrata, Rominger.
Pachydictya acuta, Hall.
Plectambonites (?) sp.
Zygospira recurvirostra, Hall.
Orthis tricenaria, Conrad.
Rafinesquina **Cf.** ***R. alternata***, (Emmons).
Trochonema umbilicatum, Hall.

Small exposures of the basal conglomerate and overlying arenaceous limestone occur on the west side of the Great Manitou island, these rocks dipping south < 5°, while on the south shore, near the old wharf, is a small outcrop of arenaceous limestone dipping east at a low angle.

From these exposures the following fossils were obtained:—

Stromatocerium rugosum, Hall.
Columnaria halli, Nicholson.
Fragments of crinoidal columns not determinable
Ptilodictya falciformis, Nicholson.
Rafinesquina Cf. *R. alternata*, (Emmons).
Zygospira recurvirostra, Hall.
Zygospira (?) sp. undet.

Lophospira bicincta, Hall.
" sp. type of *L. helicteres*, Salter.
Maclurea (?) sp. undet.
Actinoceras sp. Cf. *Actinoceras bigsbyi*, Stokes.
Endoceras, sp.
Orthoceras, sp. Probably a new species of the type of *Orthoceras rapax*, Billings. This may be referable to the genus *Cameroceras*.

Trenton.

Between Deux Rivières and Mattawa are several small comparatively flat-lying exposures of sandstones and limestones resting upon the Laurentian gneiss close to the edge of the river, that are completely covered during times of freshet. The sections exposed are of no very great thickness or extent, the beds dipping in a southerly direction at a low angle. The most important of these outliers is the one situated on the north side of the river about four miles above Deux Rivières. The basal or sandstone beds formerly furnished material for the manufacture of grindstones of an excellent quality while local lime-kilns utilized certain portions of the higher beds exposed in this escarpment.

About six miles below Mattawa two small outliers of a light-yellowish and purplish, grey-weathering arenaceous limestone are seen in the north bank of the Ottawa river, containing abundant fossils characteristic of Lower Trenton period. Besides the rock *in situ*, the beach in the vicinity of these outliers contains a large number of somewhat water-worn blocks of these fossiliferous strata.

The following list of fossils has been prepared by Dr. Ami from a collection made at this locality.

Receptaculites occidentalis, Salter.
Crinoidal fragments too imperfectly preserved for identification, but may belong to *Glyptocrinus*.
Prasopora selwyni, Nicholson, (*Prasopora lycoperdon*, Vanuxem.)
Streptalasma corniculum, Hall.
Frondose monticuliporoid (section required for identification.)
Branching form of monticuliporoid.
Obscure monticuliporoid form, probably related to *Solenopora* (Cf. *S. compacta*, Billings.)
Strophomena incurvata, Shepard.
Rafinesquina alternata, (Emmons).
Orthis, sp. Cf. *O. tricenaria*, Salter.
Orthis (Dinorthis) proavita, W. and Sch.
Zygospira recurvirostra, Hall.

Young of *Murchisonia* (possibly *Lophospira bicarinata*, Hall.)
Fragment of trilobite too imperfectly preserved for identification.

SILURIAN.

Clinton and Niagara.

The rocks of this age, exposed on the shores and islands of the northern portion of Lake Timiskaming, have been of exceptional interest to geologists ever since their discovery and description by Logan in 1845.* Geographically this outlying patch is so widely separated from any locality where rocks of similar age are now known to exist that it has been a question whether it is indicative of an area of marine submergence connected with that in which the fossiliferous strata of Hudson bay were deposited, or whether it was in some way connected with the Niagara basin to the southwest. It has been previously asserted that these rocks belong rather to the great northern trough connected with Hudson bay, of which they are probably an outlier, and the absence of all strata of Niagara age in the region bordering the lower Ottawa has served to strengthen this belief. Although in lithological character and colour the rocks of similar age exposed on Timiskaming exhibit a marked similarity to the Niagara exposed farther to the north, the rich and varied fauna characteristic of this outlier presents no corresponding resemblance, but rather a close analogy with the Niagara formation of southwestern Ontario.

It has been shown that a pronounced similarity exists both in lithological character and fossil remains between the Niagara of the Winnipeg basin and that exposed in the vicinity of the Churchill on Hudson bay, although these areas are now widely separated, while both present organic forms that are entirely lacking in the Timiskaming outlier. These facts, therefore, seem to prove that the seas in which the Niagara sediments of the Winnipeg basin and of Hudson bay were deposited were practically continuous, while both were separated from the Timiskaming basin and the region to the southwest.

The strata forming the Timiskaming outlier occur in the form of a shallow synclinal trough, occupying somewhat more than the breadth of the lake, which is here about six miles, and extending from the northern end of Moose or Bryson island, northwestward beyond the confines of the present map. On both sides of the lake the rocks incline towards the water at varying angles, depending on the character of the shore-line; although in general the dip does not exceed 10°, and angles of lesser amount are far more common. On Mann or Burnt island, as well as on the peninsula to the north, the limestones show a very gentle westerly inclination of between one and two degrees, while on Percy island,* near the west shore, the rocks are very nearly if not quite horizontal. It is thus evident that any section made must of necessity be more or less ideal and any thickness based on the observed angles of the dip is sure to be misleading. The whole thickness exposed in any one section is somewhat less than 150 feet, and it seems certain that the total amount of the Niagara exposed on this lake cannot be greater than 300 feet, and may be considerably less. The occurrence of loose angular fragments and slabs of greyish dolomite, resembling that exposed in the vicinity of Lake Huron and Nipissing, and containing characteristic Trenton fossils, has been noticed.† These are distributed at several points on the shores of the lake and specimens were collected from the northeast shore of Chief island. Although their source has not yet been ascertained the angular character of the fragments and their abundance shows clearly that this cannot be far distant. The lake is here over 200 feet in depth and it is just possible that below the Niagara limestone and concealed beneath the waters of the lake there exists an area of Cambro-Silurian rocks. This, however, can only be ascertained by boring, as no exposures of these rocks were encountered, although a diligent search was made with this object in view.

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*Report of Progress, Geol. Surv. Can., 1845-46, pp. 69-70. Geology of Canada (1863), pp. 334-336.

†Geology of Canada (1863), p. 334

The relatively smaller quantity of conglomerates and sandstones characteristic shallow water deposits, and the rapid alteration from these coarser clastics to the fine-grained limestones indicative of deep water deposition, point to a rather sudden marine invasion; while the comparatively great volume of strata remaining shows a prolonged submergence. The fine-grained character of most of the limestones show that their deposition took place in a quiet arm or extension of the sea not affected by the open ocean, while the abundance and character of the fossil remains are ample testimony of the genial charac of its waters.

As exposed on the west side of Wabis bay, in the northwest corner of the lake, the lower portion of this formation is composed of loosely coherent sandstone or grit alternating with thinner beds of fine conglomerate, with pebbles chiefly of Huronian quartzite, m of which have a thin coating of yellowish or brownish iron ox while the matrix, consisting of similar material in a finer st

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*So called in honour of Captain Walter Percy of the steamer *Meteor* pl on this lake.

†Geology of Canada (1863), p. 335

division, contains a slight admixture of calcareous matter. The actual contact between this and the underlying slate of the Huronian is not seen ,although only a few yards intervene between the exposures of the two rocks. The existing relations can, however, be made out pretty clearly, for while the compact and rather massive slaty rock which here represents the Huronian occurs in exposures with more or less rounded or hummocky outlines, the arenaceous strata of the Niagara dip off or away from these hillsides at an angle of 5°.

At Haileybury, on the western shore of the lake, close to the water's edge and cropping out from the shingle, is a small exposure of light yellow fine-grained limestone, without visible fossil remains, dipping northeast 25°. The discovery of limestone, with the general contour of the country in its vicinity, seems to suggest that a small patch of Niagara extends northerly along this shore towards Wabi bay, being perhaps three miles in length by about a quarter of a mile in breadth, underlying the clay which here effectually conceals any rocks which may be beneath.

Farther south, on Percy island, which is only a few chains in length and is separated from the western mainland by a very shallow and narrow channel, the rock exposed is a light-yellowish limestone, presenting a very uneven or cavernous surface as a result of unequal weathering. The strata are nearly if not quite horizontal, and weather from yellow to brown or almost black as a result of the iron present. Shells of various species of brachiopods are somewhat numerous. A number of the fossil remains collected have been determined by Dr. Ami as follows:—

Clathrodictyon fastigiatum, Nicholson.
Favosites gothlandica, Lamarck.
Syringopora verticillata, Goldfuss.
Crinoidal fragments.
Leptæna rhomboidalis, Wilckens.
Atrypa reticularis, Linnæus.
Meristella, sp.
Anoplotheca hemispherica, Sowerby.
Pterinea, sp.
Also branches of obscure Monticuliporidæ.

This fauna represents the Clinton, or base of the Niagara, or lower part of the Silurian.

The northern and western points of Chief island rise into comparatively high ridges of massive quartzose sandstone or quartzite-grit which present the usual rounded and glaciated outlines. Sheltered in the bay intervening between these two points is a small patch of boulder conglomerate, composed of sub-angular masses derived from the underlying quartzite. These are embedded in a calcareo-arenaceous matrix composed chiefly of pebbles and finer material, the whole representing evidently a boulder-strewn beach covered by later sediments of the Niagara formation. The surface of the quartzite on which this conglomerate rests presents the hummocky character so common in the case of the hard Archæan strata, the irregular cracks and depressions being filled by the conglomerate. Subsequent glaciation has removed much of the material, so that the exposure now presents a plane surface with a more or less net-like structure, the framework being presented by the finer arenaceous cement, while the meshes or interstices are occupied by truncated sections of quartzite boulders, as well as of the rounded hillocks of the solid rock beneath. Some of the boulders present in this conglomerate were evidently large concretions, as they exhibit concentric structure and weather very rusty owing to the disintegration of the large proportion of iron present. The finer cementing material, while relatively much smaller in amount than the pebbles and boulders, is always of a greenish or yellowish colour and frequently contains corals and orthoceratites. The action of the weather has partially obliterated the glacial striæ on this finer matrix but the sections of the quartzite boulders and hummocks exhibit these markings in great perfection.

On the southwestern shore of Chief island is another small patch of a finer grained conglomerate, the pebbles of quartzite being less numerous and of much smaller size, while the matrix contains much more calcareous matter. The rock dips southeast 5°.

A number of rather badly preserved fossils were secured at this locality, which have been named as follows by Dr. Ami:—

Halysites catenularia, Linnæus.
Columnaria, sp., with very irregularly disposed horizontal tabulæ.
Zaphrentis, sp.
Streptelasma or *Caninia*, sp.
Rhynchonella, sp.
Murchisonia, two species.
Euomphalus, very large species.
Discosorus, Cf. *D. conoideus*, Hall.

The above fauna represents the Clinton formation or lower portio of the Niagara.

On the east side of the lake, from the point south of Chief islan to within less than a quarter of a mile from Piché point, the shore i occupied by a narrow fringe of the basal conglomerates and sandstones of the Niagara. The coarser beds are of the boulder conglomerates already described, representing simply a talus of angular and sub-angular fragments detached from the elevations in the immediate vicinity of the exposures, consolidated together by a finer grained arenaceous cement of a yellowish colour, in which are also embedded fragments of corals and orthoceratites.

This boulder conglomerate passes upward into a fine conglomerate, in turn replaced by a coarse grit, and becoming finally a yellowish rather friable sandstone. These beds run in long undulating curves, closely following the general outline of the underlying quartzite, with a general westerly dip at angles varying from 10° to 15°. The action of the waves has in places caused this to disintegrate very unevenly leaving a rough pitted surface. At Piché point and for some distance north the Huronian quartzite is left entirely denuded of these deposits.

In the bay to the south of Piché point, and between this and Wright's silver mine, there are two small patches of thinly bedded light-yellow arenaceous limestone dipping in a southerly or southwesterly direction ∠ 5°; immediately south of Wright's mine is another small patch of similar arenaceous limestone dipping southwest ∠ 9°.

On the east shore of the lake, nearly opposite Bryson island, there are two more small patches of the arenaceous limestone exposed at the shore, wrapping round the hummocks of Huronian quartzite and dipping in a southerly or southwesterly direction ∠ 5°. None of these small patches of limestone contained any visible fossil remains.

On Mann island, as also on the two small islands between this and Bryson island (Oster and Brisseau islands), as well as on the high promontory separating Wabbi and Sutton bays in the northern part of the lake, are exposed the limestones and shales that represent the deep-water deposits of this period. The limestone is of a pale-yellow or cream colour, weathering whitish, and varies in thickness from a few inches up to two feet or over. Some of the beds are very fine-grained and of rather even texture, and it is possible that some parts may prove to be sufficiently uniform for use as lithographic stone. As a building stone it is of excellent quality. These limestones, on the north shore of the lake at Dawson point, dip a little south of west at an angle of between one and two degrees, rising into cliffs of over a hundred feet in height on the west side of Sutton bay, and forming a somewhat elevated rocky plateau with a gentle westerly slope, corresponding mainly with the angle of dip towards Wabi bay. The east shore of Mann island presents a somewhat similar, though much lower, escarpment, while the western shore is a gently shelving beach, which at low water reveals considerable areas of the almost horizontal limestones. Some of the beds contain a considerable proportion of silica of a cherty character, and all the fossils are more or less silicified. The action of the weather causes them to stand out in relief and often displays their minute structures perfectly. A large collection of these fossils was made along the western shore of Mann island, comprising the following forms as determined by Dr. Ami and Mr. L. M. Lambe:—

Bythotrephis (Chondrites) gracilis, Hall.
“ Cf. *B. palmata*, Hall.
Clathrodictyon fastigiatum, Nicholson.
Cyathophyllum articulatum, Wahlenberg.
“ *americana*, Milne-Edwards and Haime.
Favosites gothlandica, Lamarck.
Alveolites niagarensis, Rominger (non Nicholson).
Cladopora crassa, Rominger.
Syringopora verticillata, Goldfuss.
“ bifurcata, *Lonsdale*.
Halysites catenularia, Linnæus.
“ *compacta*, Rominger.
Lyellia affinis, Billings.
“ *Americana*, Milne-Edwards and Haime.
Thysanocrinus liliiformis, Hall.
Dendrocrinus longidactylus, Hall.
Taxocrinus n. sp.
Lichenalia concentrica, Hall.
Phænopora expansa, Hall.
Trematopora sp.
Orthis (Dalmanella) elegantula, Dalman.
Orthis calligramma, Dalman.
Platystrophia biforata, var. *lynx*, Eichwald.
Strophomenoid shell, type of *Rafinesquina*.
Stropheodonta sp. (? n. sp.)
Leptæna rhomboidalis, Wahlenberg.
Atrypa reticularis, Linnæus.
“ *intermedia*, Hall.
Trematospira sp.
Pentamerus oblongus, Sowerby.
Euomphalus alatus, Hisinger.
Murchisonia sp.
“ *subulata*, Hall.
Discosorus conoideus Hall.
“ *gracilis* ? Foord.

Orthoceras, sp.

" *sp., Cf. O. virgulatum*, Hall.

Orthoceras Cf. O. cadmus, Billings. *Cf. O. sub-cancellatum*, Hall.

Actinoceras vertebratum, Hall. *A. Backi*, Stokes.

Calymene niagarensis, Hall. Probably identical with *Calymene blumenbachii*, Brongniart.

Beyrichia, sp. Cf. B. lata, Hall.

PLEISTOCENE.

The Pleistocene history of this and adjacent regions seems to be in the main divisible into two parts. (1) That of great accumulation of snow and the production and maintenance of a confluent ice-sheet. This is believed to have been accompanied, if not caused, by a vast regional uplift, increasing in amount to the northeastward. Following this came (2) a profound submergence, during which time the ocean invaded a large portion of the Ottawa valley, forming a marine gulf rivalling in extent and depth similar encroachments made by the sea during portions of the Palæozoic. The researches already made seem to show that channels may have connected that portion of the ocean covering the St. Lawrence and Ottawa valleys with that existent in Hudson bay, while the marine invasion may have been continuous over a vast inland basin represented at present in part by the area of the Great lakes.

Taylor, Chalmers, Gilbert, Wright, Spencer and others have been at work in this and neighbouring districts connecting and correlating the beaches representing the various stages of this submergence, but it is only possible within the scope of the present report to point out in the most general way some of the important results obtained. Taylor has shown that immediately following the retirement of the great ice-sheet wh [illegible] rked the first part of the Pleistocene, and to which referenc [illegible] rtly be made, an important strait or arm of the sea covered t [illegible] wa and Timiskaming valleys, while later, as the flood subsided and the ice receded from parts of the area previously held by it, most of the waters of the Great lakes emptied for a considerable time eastward into the Ottawa through the Mattawa valley. Beaches marking the successive stages in the subsidence are well exposed on the hillsides to the north and south of Lake Nipissing, especially in the vicinity of North Bay, where they were found and described by Taylor and Wright, while the valleys of both the Mattawa and Ottawa rivers present many evidences of having been occupied for a somewhat protracted interval by a stream rivalling, if not exceeding, the St. Lawrence in volume.

In the present report the existence is assumed of a vast superincumbent glacier, of which the chief gathering-ground, as indicated by existing striæ and distribution of drift material, was situated directly over the water-shed between Hudson bay and the St. Lawrence river. This hypothesis appears to offer the most satisfactory and comprehensive explanation of the various phenomena, while at the same time it is one in accord with views that have already received most general recognition among the students of Pleistocene geology.

Although thus generally agreed as to the agency producing the various results encountered, a considerable diversity of opinion exists among geologists as to whether the large number of observations already made can be adequately explained on the theory of one great ice-flow with minor oscillations, or of several distinct epochs of glaciation, each with its own proper ice-mass and separated from one another by interglacial periods during which much milder climatic conditions prevailed. The information obtained from the examination of this district is not sufficient to afford a basis of argument in favour of either view. It is, however, easy to understand that while areas situated near the extreme border of the ice-sheet may have enjoyed comparatively long interglacial periods, during which the climate was of such genial character as to permit and favour the growth of a somewhat luxuriant vegetation, others, in regions farther removed to the northeast and near the centre or centres of accumulation, showed very little, if any, amelioration of temperature. The divergence in existing striæ observed throughout this district seems perfectly explicable on the theory of differing phases of one great glacier, with comparatively short intervening lapses of time during its temporary recession and subsequent re-advance.

As the position of these first-formed ice-masses would of necessity be largely determined by the position of the highest land then existent in this region, it is probable that very early in the Glacial period there were two main gathering grounds or centres of dispersion for such ice. These would be situated respectively in the area to the northwest of Lake Timiskaming, in the vicinity of the 'Great bend' of the Montreal river, and the high quartzite ridges to the west of Lady Evelyn lake, and on the high rocky hills known to exist in the vicinity of the hight-of-land to the northwest of Lake Timiskaming. It is probable that early in the ice age these local centres sent out glaciers which flowed over the lower lands and valleys to the south, and may have been the cause of some of the striæ observed on the rock-surfaces exposed in the valley of the Montreal river, as well as on the shores of Lake Timiskaming. Although it is possible that all such evidences may have been so obscured in the profound general glaciation which followed as to render their recognition and correlation matters of extreme difficulty. We may suppose that glaciers of the kind above referred to, increasing under favourable conditions, eventually coalesced as parts of one great ice-sheet, of which the distributing centre may have been gradually shifted eastward towards the neighbourhood of Opasatika and Labyrinth lakes on the canoe-route to Lake Abitibi. There is likewise sufficient evidence afforded by a study of the later striations, that must have been caused by temporary re-advances in the waning ice-sheet, that this eastward shifting of the main gathering-ground must have slowly continued, while the final recession was almost directly northeast.

It is now a well ascertained fact that the motion of ice is one resulting from its plasticity, resembling substantially the movement which obtains in an extremely thick and viscid fluid when spread upon any surface and a supply of fresh material constantly added. It is, therefore, obvious that any inclination, however slight, of the underlying surface, or the interposition of natural barriers at or near the sources of supply, were in the first instances the determining causes of the general direction of the ice flow. This onward motion once imparted was continued, and depended subsequently not so much on the nature of the land surface on which the glacier reposed as upon the general slope of the upper surface of the glacier, which inclination was imparted as a result of the unequal accumulation of material at the centres of dispersion. To the north and northeast of Lake Timiskaming the various passes or valleys leading northwards across the height-of-land are a little less than 1000 feet above the sea, although the rocky elevations in the immediate neighbourhood rise in general from 200 to 500 feet higher, while some of the hills in the vicinity of Labyrinth and Opasatika lakes show an elevation of over 600 feet above the surrounding lakes. If added to the general slope thus obtained be taken the rise consequent on a differential uplift gradually increasing in a northerly direction, the resulting slope would be sufficient to compel a somewhat rapid southwesterly flow in any glacier formed in this vicinity, while in addition it is probable that an ever increasing supply of icy material to the northeast might so accelerate this onward motion that even the interposition of such formidable natural barriers as the deep gorge of Timiskaming must have been, with its steep opposing slope, only served as temporary checks.

This great ice-sheet acted as an important agent of transportation, catching up and carrying forward large quantities of clay, sand, gravel and boulders from the higher elevations on the north to fill up the various inequalities of contour existing farther south. The drift material, though varying very much in this region, is as a rule very coarse on the higher levels and on the hill-sides facing towards the south and southwest. On these higher levels the ground is very much encumbered by more or less rounded or subangular boulders which usually do not show transportation from any great distances; although by a careful comparison of the material of this drift it was ascertained that many of these loose fragments had been carried as much as fifty or sixty miles, in a direction closely corresponding with the striation marking the maximum extension of the ice-sheet over this district. Thus, loose fragments of the buff-coloured limestone with characteristic nodular cherty matter, known to occur in a patch of somewhat limited area in the vicinity of the northern part of Lake Timiskaming, were found on Marten or Crooked lake in the township of Gladman, a distance of over fifty miles from where such rock is now found in place. The distribution of these characteristic fragments, which are an especially valuable criterion of the direction of ice-flow on account of the known limited extent of this Silurian outlier, shows that the agency which affected their transportation had a direction of movement varying from S. 7° W. to S. 18° W., thus agreeing very closely with the most abundant and pronounced striæ. On Lake Nipissing the various shales and greywackés characteristic of the Huronian exposed in the area of the Lake Timiskaming map-sheet, are rather plentifully represented among the loose boulders fringing the shores.

The stratified sands and clays so abundant in the area to the north of Lake Nipissing, as well as those in the vicinity of the Veuve river, were probably deposited very rapidly from streams issuing from the margin or front of the retreating glacier, as was likewise no doubt the case with the thick and widespread deposits of stratified clay which forms such extensive flats in the region bordering the northern portion of Lake Timiskaming. The terraces characteristic of the occurrence of these clay deposits to the north of Lake Timiskaming merely serve as marks accentuating the various stages or haltings in the ice-sheet, of which the margin was buried beneath the rising waters, thus permitting and even favouring such a mode of deposition of the englacial detritus. Especially along the course of the Ottawa and Timiskaming valley the region exhibits frequent great accumulations of morainic *débris* marking the recession of the ice-lobe occupying this deep and important depression. These deposits from the drift-laden glaciers are described in some detail in the geological description covering the area immediately bordering these topographical features.

Besides the removal and transportation of boulders, gravel and other material, there is abundant evidence everywhere of considerable abrasion of the surface produced by the passage of the ice-sheet across this district. Throughout the whole area covered by the accompanying map-sheets most of the rocky elevations have been smoothed and in many cases even polished, while scratched or striated surfaces are also common. These striæ are usually long, more or less parallel scratches, varying in size from extremely fine lines which can often only be detected by very close scrutiny, to furrows several inches in depth and width. They have in general a somewhat constant direction except in the vicinity of deep and narrow valleys, where they frequently show considerable divergence from the average direction of the district. Many of these striæ consist of a series of irregular, curving and often faint scratches, as if occasioned by an uncertain or intermittent action, while some of the deeper and more pronounced furrows exhibit irregular broken cavities at intervals in their course as though produced by a "bumping" action caused by hitches in the rocky implement producing them.

Ledges and ridges which have been long exposed to the action of the weather usually reveal little or no evidence of such striation on account of the sub-aerial decay to which the rock has been subjected, while, on the contrary, rock exposures which have been but lately denuded of their overlying soil, as well as those portions of the rocky shores of the various lakes and streams exposed only between extremes of high and low water, usually exhibit such markings in great perfection. The various gneisses and granites of the Laurentian areas are so faintly marked, if at all, that the direction of the striæ can seldom be ascertained with any degree of certainty. There seems no reasonable doubt that such markings were originally present, as under the favourable conditions already mentioned they are often plainly discernible, but as a rule prolonged atmospheric decay has so acted on exposed surfaces of these rocks that their surfaces have become roughened. On the other hand, on exposures of Huronian rocks such as slate, greywacké, quartzite and especially diabase and gabbro, these glacial markings are very frequently to be observed in all their pristine freshness. In many localities, particularly in the area covered by the Lake Timiskaming sheet, there are two, three and even four sets of striæ on the same rock-surface, differing somewhat in direction, and marking, as a rule, but slight changes in the direction of the ice-flow, during successive re-advances of the ice-sheet. The correlation of such striæ is usually exceedingly difficult and unsatisfactory, as the intervening lapse of time denoted by these divergences was doubtless of comparatively short duration.

It is probable, as has been stated, that early in the ice age glaciers of the alpine type occupied the high hills of diabase and gabbro in the vicinity of the height-of-land immediately west of the canoe-route between Lac des Quinze and Abitibi, as well as on the high ridges of quartzite grit to the west of Lady Evelyn lake, of which Maple mountain is the most prominent eminence. The striæ which have the closest correspondence with the general trend of the valley of Lake Timiskaming and the Ottawa river were possibly caused by such a local glacier, as these markings are earlier than those which trend to the east on the one hand or to the west on the other. The striæ marking the main advance of the ice-sheet in this region show a general trend of about S. 14° W., but many of the observations noted present a marked divergence from this general direction, especially those made in the vicinity of lakes and streams where these ice markings show an unfailing tendency to conform very closely to the direction of the enclosing valleys.

The earliest of these southwesterly ice markings are those which run nearly south, the direction of ice-flow showing a gradual change in the direction of successive re-advances, following temporary recessions, from a little west of south to almost directly southwest.

In the area covered by the northern and central portions of the Lake Timiskaming sheet there are many lakes whose general trend makes but a small angle with the average direction of ice-flow while their containing valleys are narrow, rocky and steep. The northern part of Timagami, Waibikaiginaising and Wakemika lakes may be cited as examples where the glacial striæ show a general direction of a little east of south, in this respect showing the marked influence of topographical outline.

In the subjoined list, which is necessarily brief and incomplete, consisting of observations made during an exploration whose primary object was to map out and report upon the various subdivisions of the Archæan rocks, an attempt has been made wherever possible to tabulate in regard to their age the various striæ observed. Where two, three, and even four sets are noted as occurring on the same rock-surface, the order in which they appear is believed to represent, with approximate accuracy, their relative ages from the oldest to the most recent.

List of Glacial Striæ.

Lake Timiskaming.

Wabis bay, west shore of, on lot 10, con. V. Buckle township.	S 15 E S 45 W
Wabis bay, east shore of, on lot 2, con. I. Harris township.	S 19 E
Sutton bay, northeast shore of, on lot 8, con. V. Harris tp.	S 51 E
East shore, west of Apika creek, on lot 38, con. I. Guigues tp.	S 81 E
Chief island, east shore of	S 36 E
Chief island, north shore of	S 66 E
Chief island, west shore of	S 14 E S 48 E S 54 E
East shore, on lot 31, con. I. Guigues township	S 32 E
Piche point, south of, on lot 12, con. I. Guigues township	S 33 E S 46 E
East shore, north of Wright's mine, on lot 7, con. II. Guigues tp	S 23 E S 43 E
Wright's mine, (Lake Timiskaming Silver mine) on lot 62, con. I Duhamel township "Block A"	S 21 E S 31 E S 60 E
Joanne bay, east shore of, on lot 58, con. I. Duhamel township	S 28 E S 11 W
East shore, on lot 54, con. I. Duhamel township	S 26 E South
East shore, at Narrows with Bryson island on lot 44, con. I. Duhamel township	S 21 E
East shore, opposite Drunken island, on lot 31, con. I. Duhamel township	S 4 W
West shore on lot 14, con. IV. Lorraine township	S 4 W
West shore on lot 12, con. VI. Lorraine township	S 21 E
West shore on lot 11, con. VII. Lorraine township	S 12 W S 18 W
West shore, on lot 15, con. 1. Bucke township	S 18 E S 26 W
Laperriere bay, north shore of, ½ a mile east of old H. B. Co's post, on lot 7, con. II. Duhamel township	S 21° E S 6° W
Islet near east shore about 1 mile southeast of Roche McLean	S 17 W S 32° W
Roche McLean, near west shore	S 10 E
West shore opposite Roche McLean	S 4 E
West shore 1½ miles north of Montreal river	S 4 W
West shore 1½ miles south of Montreal river	S 21 E S 19 W

Quinze river.

Islet opposite North Timiskaming P.O. Near southeast shore	S 21 E S 31 E
At second rapid above Lake Timiskaming	S 50° E
On new road to Lac des Quinze, 6 miles east of First rapid on River des Quinze	S 47° E

Lake Timagami.

Northeast arm, west end of portage to Caribou lake	S 4 W S 14 W S 19 W
Northeast arm, island in south narrows, two miles west of portage to Caribou lake	S 16° W
Northeast arm, islet near south shore, ½ mile southeast of Ferguson island	S 16° W S 20° W
Northeast arm, island east of Broom island	S 14° W
Northeast arm, point on south shore ½ mile southeast of Broom island	S 9° W S 24° W
Ko-ko-ko bay, east shore of, 1½ miles south of north end	S 9° W

Ko-ko-ko bay, islet near centre, 2½ miles south of north end.	S 14 W
Ko-ko-ko bay, islet near west side, 3½ miles south of north end	S 8 W
Ko-ko-ko bay, east shore of, 3¾ miles south of north end.	S 6 W S 1 E
Ferguson bay, east side, near southern end	S 6 E
Ferguson bay, point on west shore 1¼ miles south of Ferguson point	S 8 W
Sandy inlet, point on southeast shore ½ mile east of Ferguson point.	S 1 E S 18 E
Sandy inlet, northeast shore, near mouth of Annima-Nipissing river	S 1 E S 18 E
Whitefish bay, east shore, 1½ miles south of creek from Whitefish lake	S 11 E S 4 W
Whitefish bay, point on west shore ½ mile southwest of creek from Whitefish lake	S 28 E
Whitefish bay, islet in, nearly 1 mile south of creek from Whitefish lake	S 1 E S 16 E S 9 E
North arm, point on west shore, ¼ mile south of Deer island.	S 14 E S 19 E
Southwest arm, island near north end of	S 9 W
Southwest arm, east shore of, 2 miles southwest of Narrows island	S 19 W S 4 W
Southwest arm, east shore of, 5 miles northwest of south end.	S 14 W
Islet 1½ miles southwest of Hudson's Bay Co's post	S 4 W S 11 W S 29 W
Islet 1¾ miles east of Hudson's Bay Co.'s post	S 9 W S 1 E
Islet near north end of Island bay	S 12 W S 29 W
Portage near south end of McLean peninsula.	S 4 W S 24 W
High Rock island, southeast shore of.	S 29 W

Cross lake.

West shore of lake, 1½ miles south of Timagami River inlet	S 5 W
North point of island, 1¾ miles south of Timagami River inlet	S 3 W
East shore of same island, 2 miles south of Timagami River inlet.	S 2 E S 7 W
West shore, ¼ mile north of Timagami River inlet	S 13 W S 2 E
West shore, 1¼ miles south of Timagami River inlet	S 8 W
Small island near west shore 1¾ miles north of Timagami River inlet	S W S 15 W
Point on west shore 1¾ miles north of Timagami River inlet.	S 5 W

Area Southeast of Lake Timagami.

Island near southeast end of Jumping Cariboo lake	S 14 W
Marten lake, southwest shore of, ½ mile northwest of north town line of McLaren	S 20 W S 2 W
Islet in Red Cedar lake, lot 6, con. VI., Thistle township	S 12 W
Temiko lake, northwest shore of, on lot 5, con. I., Fell township	S 15 W
Moxam lake, northeast shore of	S 4 W S 22 W S 29 W
Expectation lake	S 22 W S 22 W
Simpson lake, at outlet of	S 22 W
Simpson lake, islet near northeast end of	S 22 W
Mackenzie lake, islet near east end of	S 14 W
Mackenzie lake, east end of	S 21 W
Breadalbane lake	S 30 W
Bush lake (near headwaters of Ottertail creek)	S 30 W
Poplar lake, west shore of, on lot 2, con. III., Gladman township	S 7 W
Kaotisinewaning lake, south shore of, in Notman township	S 20 W
Red Water lake, west side of, near ¼ mile from outlet	

Lake Nipissing

Goose islands	S 25 W S 30 W
Manitou islands, in S. eastern side of	South
Small islands in Goulais bay	S 15 W
Goulais point	S 25 W
Small island opposite lot 5, con. C, Caldwell township	S 10 W
North shore of, on lot 7, con. C, Caldwell township	S 20 W
North shore of, on lot 11, con. C, Caldwell township	S 25 W
Point on west shore	S 30 W
Southeast shore of Bear bay, opposite Muskinonge island	S 10 W
Deer bay, south shore of west arm	S 20 W
North shore of, on lot 6, con. C, Springer township	S 14 W
North shore of, on lot 5, con. C, Springer township	S 12 W
North shore of, point 3 miles east of Dukis point	S 10 W
North shore of, point 1 mile east of Dukis point	S 14 W
Clark (Sandy) island, near western end	S 30 W S 35 W
Hardwood islands, west end of	S 20 W
Island east of east end of Hardwood islands	S 25 W
South bay, east shore of	S 23 W

Lady Evelyn lake and vicinity

Point on north side of largest island in Lady Evelyn lake, 3 miles southwest of Obisaga narrows	S 4 W
Island in Lady Evelyn lake, 3½ miles south of Obisaga narrows	S 6 W
Southwest shore Nonwakaming lake, 3 miles west of inlet	S 5 W S 21 W
Island near east shore Nonwakaming lake, about 2 miles northwest of inlet	S 5 W S 20 W
West shore Wakemika lake	S 8 E S 22 E
South shore Wakemika lake	S 3 E S 17 E
Turner lake, southeast shore of	S 10 W

Area northeast of Lake Timagami.

Net lake, east shore of, near north end	S 4 W
[illegible] lake, south end of	S 5 W
Kokoko lake, east shore of, ½ mile north of outlet	S 18 W
Kokoko lake, east shore of, 2½ miles north of outlet	S 2 E S 3 W
Tetapaga lake, north shore of, 1 mile east of outlet	S 1 W
Turtle lake, north shore of	S 1 W S 25 W

Vermilion lake

Turtle lake, small island near north shore of	S 10 W S 15 W S 30 W S 52 W
Waiekagamasing lake, island near east shore of, 3 miles from south end	S 6 E S 6 E S 29 E
East end of portage between Summit and Friday lake	S 8 E S 18 E
Friday lake, west shore of, 1½ miles north of outlet	S 6 E S 16 E
Bear lake, east shore of, 2 miles north of outlet	S 4 W
Island in Vermilion lake, ½ mile southwest from northeast end	S 8 W

Wickstead (or Shabosaging) lake

On Rocky islets, 1½ miles southwest of inlet....	S 14 W S 27 W
On southeast shore, 1¼ miles southwest of inlet	S 27 W
On northwest shore, 2 miles southwest of inlet	S 24 W
On Rocky islet, 4½ miles southwest of inlet	S 27 W
At Narrows, 2½ miles northeast of outlet	S 14 W S 24 W
On islet near west shore, 4½ miles southwest of inlet	S 24 W S 34 W
On islet near west shore of big western bay, 4 miles southwest of inlet	S 19 W S 24 W S 2[illegible] W
On west shore, 1 mile northeast of outlet	S 31 W

Annima-Nipissing lake and vicinity.

West shore of bay on route to Mountain lake	S 10 E S 2 E S 5 W
Island near centre of lake, 4 miles from north end.	S 6 W S 5 W S 9 W
West shore, 3½ miles from north end	S 25 W S 20 W
Gull Rock lake, northeast shore ...	S 20 W S 7 W
Carrying lake, south shore of	S 20 W
Diabase lake, south shore of .	S 3 W S 18 W

Rabbit lake and vicinity.

Rabbit chute on Matabitchouan river, at outlet of lake	S 1 W S 8 W
West side, ¾ mile south of Rabbit chute	S 3 W S 7 W
Burnt point, on west side of south end of Outlet bay	S 8 W S 3 W S 8 W
Southeast shore, 1 mile northeast of Rabbit point	S 13 W S 2 W
Point on east shore, ½ mile north of Rabbit point ..	S 13 W S 35 W S 42 W
Island in Rabbit lake, opposite Rabbit point.	S 5 W S 4 W
Ross lake, south shore of	S 22 W S 29 W
White Bear point on west shore lake ...	S 3 W S 8 W
Island in White Bear lake, near northeast corner .	S 15 W S 40 W

Montreal river and vicinity.

South end of Mountain or Round lake	S 42 E
On islet in river, 1 mile below Mud Lake portage	S 22 E
At Fountain falls	S 17 E
Island near west shore, near north end of [illegible]	S 40 W

ECONOMIC GEOLOGY.

Gold and Silver.

Throughout the whole of the large area coloured as Laurentian on the accompanying map-sheets very coarse aggregates of quartz and feldspar with more or less mica, known as pegmatites, are of frequent and often rather extensive occurrence. In origin they are distinctly igneous and intrusive and in many localities are dike-like, often branching and cutting across the foliation of the gneissic rocks, although in other instances they occur as coarse-grained bands or belts interfoliated with the finer grained granite-gneiss. These acid bands sometimes become finer grained and not infrequently shade imperceptibly into the mass of the gneisses with which they are associated.

Early in 1887 the town of Mattawa was startled by the report of the discovery of gold in considerable quantity in a large number of these quartzo-feldspathic masses cutting the gneissic rocks in the immediate vicinity. An examination was undertaken of these so-called gold-bearing quartz-veins, and a number of samples taken to represent nine of the principal localities were submitted to Dr. Hoffmann, Chemist and Mineralogist to the Survey, which when assayed furnished only negative results in the case of both gold and silver. The following table shows in a concise manner the results thus obtained*:—

Locality	Description	Gold	Silver
Mattawa hill on north side of Ottawa river.	Quartz and feldspar, pegmatite: large samples from five different localities.	None	None
Hill on east side of Ottawa river 3 miles north of Mattawa.	Quartz and feldspar in mica schist.	None	None
[illegible] miles west of Mattawa and a mile north of McCool's mill.	Quartz with a little feldspar. Large samples from three different localities.	None	None

About the same time samples from apparently segregated veins of quartz, containing more or less disseminated sulphides and cutting what has been mapped as Laurentian gneiss in the Lac des Quinze region, were obtained by Mr. C. C. Farr of Haileybury, Ont. These were sent to the Geological Survey and handed to Dr. Hoffmann whose assays showed only traces of the precious metals. The following table condensed from Dr. Hoffmann's report will show the result of his examinations and assays*:—

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* Annual Report Geol. Surv. Can., Vol. III, (N.S.), 1887-88, [illegible] Assays Nos. 22-30.

Locality.	Description of Specimen.	Weight.	Gold per ton.	Silver per ton.
Route to Abitibi, 8 miles S. Height-of-land.	Chalcopyrite and quartz.	1½ oz.	Trace	None
R. A. Klock's limit, north shore Lac des Quinze.	Pyrite and pyrrhotite and quartz	4½ "	"	
Lac des Quinze, northeast end.	Pyrite in quartz with ferric hydrate.	8 "	"	Trace

In addition to these samples of quartz, containing in some cases pyritous material, were sent to the Director of the Geological Survey, but their assays by Dr. Hoffmann did not afford any encouraging results so far as regards their gold and silver contents. These samples were from Lake Nipissing and the region adjacent and the results of their examination in the laboratory of the Survey may be referred to as follows†:—

Locality.	Description of Specimen.	Weight.	Gold per ton.	Silver per ton.
Sturgeon R. (branch of) N. of Badgerow tp.	Finely crystalline galena and chalcopyrite with a little quartz.	6¾ oz.	very distinct traces.	15·75
Small island in Lake Nipissing.	Chlorite-schist, mica-schist, gneiss and calcite with a little pyrrhotite and pyrite.	2 "		·116
Vein crossing inlet, W. end Lake Nipissing.	Rust-stained quartz and gneiss	8 "	none	none
Great Manitou island, Lake Nipissing.	Feldspar and quartz with molybdenite and pyrite.	¼ "	"	
Two miles W.N.W. of North Bay.	Rust stained quartz with pyrite.	4¼ lbs.	"	

In the area characterized by the presence of Huronian rocks and their associated eruptives, a large quantity of whitish or greyish translucent quartz is an almost invariable accompaniment of any extended exposure of rock. This quartz is seen to represent segregations of secondary silica filling in the various cracks and fissur caused by the profound orographic movements through which these strata have passed. Sometimes this vein-quartz is in the form of lenses or eyes occupying various small gaps or openings in the rocks, these gradually increasing in size until lenticular masses of quartz of considerable dimensions are formed. In some cases these masses run for considerable distances and approximate in character to true fissure veins, although large and typical examples of such veins are exceedingly rare in this region. Both in their horizontal and vertical extensions these "gash-veins" are exceedingly irregular, and in no case noticed can any great reliance be placed on their persistence in any direction. Calcite and dolomite often occur in association with the quartz of such veins, with varying quantities of pyrite, chalcopyrite and galena; while sphalerite and hematite (micaceous iron ore), are occasional constituents. The quartz is very often more or less cavernous or cellular, owing to the oxidation and partial removal of the sulphides originally present. Where pyrite has been abundant the quartz is more or less rusty, while the various cavities are partially filled with ochreous material. On the other hand, where copper-pyrites is the more abundant, the quartz is more or less stained and coated with green and blue carbonates of copper. Occasionally the galena shows a thin coating of carbonate of lead (cerussite) where exposed to atmospheric action, and Dr. Hoffmann makes a note of its occurrence at the Macinac lead-vein on Haycock's location, east side of Lady Evelyn lake, one and a quarter miles south of the outlet.*

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*Annual Report, Geol. Surv. Can., vol. III. (N.S.), 1887-88, part T, analy- Nos. 11-13.

†Annual Report, Geol. Survey, Can., vol. II. (N.S.), part T, analysis No. 53 Vol. IV. (N.S.), 1888-89, part R, analyses Nos. 82, 84 and 86.

In origin many of these quartz veins, and especially the larger ones, are connected with the eruption of the large masses of diabase and granite that invade the stratified slaty rocks, and often they are either on the line of junction between these two rocks or occupying breaks and fissures in its immediate vicinity, produced during the eruption of these igneous rocks. Occasionally such secondary veins of quartz occur in irregular fissures in the diabase itself.

Some of the most important of such veins noticed occur on the "Mattawapiki," as the last stretch of Lady Evelyn lake before reaching the Montreal river is called. The western shore of this portion of the lake is composed of diabase that rises abruptly from the surface of the water and often from steeply sloping or perpendicular cliffs. The contact between this rock and the slates is concealed for the most part by the lake, the eastern shore being altogether composed of a very distinctly banded greenish slate, which also rises into rather important elevations, having apparently been protected to a considerable extent from denudation by the proximity of the more unyielding diabase. The contact, for a short distance, runs inland along the western shore, leaving a comparatively narrow strip composed of the slates, which are seen to have been much shattered and broken up by the intrusion of the diabase. Some considerable masses of segregated quartz were here noticed filling irregular cavities and fissures produced during the eruptions. Associated with the quartz is more or less calcite, and in this gangue were noticed galena, copper-pyrites, iron-pyrites and zinc-blende. The banded slates on the eastern shore dip in an easterly direction at an angle of about 18°, and associated with and cutting these are similar segregated masses or "gash-vein," in which galena is the prevailing constituent. The property on which these veins are situated is owned by Messrs. Klock and Haycock, and is locally known as the Haycock mine or location. A considerable amount of development work has been done, looking chiefly to testing the quality and extent of the ore-bodies, but the inaccessibility of the locality would be a sufficient hindrance to any further operations, unless the deposit should prove of an exceptionally rich character. Assays of representative samples from these and similar veins exposed in the immediate neighborhood have been made in the laboratory of the Survey, which may be summarized as follows*:—

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*Annual Report, Geol. Surv. Can., vol. IV (N.S.), 1888-89, part R, analysis No. 60.

Locality.	Description of Specimen.	Weight.	Gold pr. ton	Silver pr. ton.
W. side Lady Evelyn lake, near outlet.	Quartz with a little calcite and chalcopyrite	1 lb. 5 oz.	Traces	2·04
E. side Lady Evelyn lake, 1½ miles S. of outlet.	Galena with a little quartz and calcite.	6 lbs. 12oz.	"	8·75 oz
W. side Lady Evelyn lake, 1½ miles S. of outlet (north vein).	Quartz with a little chalcopyrite, galena and zinc blende	2 lbs.	None	0·117 oz
W. side Lady Evelyn lake, 1½ miles S. of outlet (south vein).	Quartz with chalcopyrite...	2 lbs.	"	Non
W. side outlet Lady Evelyn lake (west vein).	Quartz with calcite, dolomite, serpentine and chalcopyrite	1 lb. 12 ox.	"	
Island at Narrows, 3 miles S. of outlet of Lady Evelyn L.	Quartz with chlorite.......	13 oz.	"	

The Cockburn location or mine covers several small islands in Cross lake, near the inlet from Timagami lake. On these islands, several masses of segregated quartz are exposed, but these apparently have no great regularity or persistence. The largest of these so-called veins is situated on the west side of an island about a quarter of a mile in length, about half a mile southwest of Timagami river. The island is composed of a geenish-grey greywacké, slaty in structure, which has undergone considerable alteration, and sericite is rather abundantly developed, especially on the planes of cleavage. The pressure or foliation planes, which are here apparently the only structural features displayed by these rocks, have a strike N. 16° E., and an inclination eastwards< 71°. The quartz fills an irregular fissure in the slates, is about five feet in width, has a strike of N. 38° E., and an underlie towards the southwest< 45°. Galena, iron-pyrites, copper-pyrites and malachite were all noticed embedded in the quartz. Samples taken to represent the average of these were examined in the laboratory of the Survey with the following results*:—

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*Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, part R, analyses Nos. 59-64.

Locality.	Description of Specimen.	Weight.	Gold per ton.	Silver per ton.
		lb. oz.		
Island in Cross lake near outlet	Quartz [illegible] and chalcopyrite	1 10	none.	·175 oz.
Cross lake..	Quartz with chalcopyrite ...	9	·058 oz.	2·058 oz.
Cross lake (same loc. as last)	Quartz with galena..	¼	trace	3.333 oz.

Mr. P. A. Ferguson of Mattawa owns three mines or locations on Lake Timagami, known respectively as A, B and C. At location A, situated on the east side of Sandy inlet in the northern part of the lake, the rock is for the most part a massive dark-green medium-textured diabase, much of which is broken up; the irregular cavities being filled with quartz and calcite, with which are associated yellow epidote and small dodecahedral crystals of red garnet. One of the veins from which considerable material had been taken was noticed near the water's edge and contains in addition to the minerals mentioned above a little iron-pyrites and copper-pyrites. The vein is very irregular and only about a foot in width and thus too small to constitute a workable deposit. At location B, situated on the north side of the northeast arm of Lake Timagami, about two miles east of the portage into Caribou lake, the rock is a pearly greyish-green sericite-schist, striking N. 68° E. and dipping northwards< 70°. Associated with this is a lenticular mass of light-grey rusty weathering dolomite, containing reticulating veins of quartz that stand out on weathered surfaces. Chiefly at the contact between these two rocks is a considerable deposit of iron-pyrites, with a little copper-pyrites and arsenopyrite (?). Location C. is on an island now known as Ferguson island, to the southwest of this point, and consists of iron-pyrites in association with sericite schists.

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*See Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, part R, analyses Nos. 54, 57 and 58.

Assays of specimens taken as representatives of these three deposits gave the following results in the laboratory of the Survey*:—

Locality.	Description of Specimen.	Weight.	Gold per ton.	Silver per ton.
Ferguson location A, Sandy inlet, L. Timagami	Quartz with little pyrite and chalcopyrite.	11 lbs.	trace	trace
Ferguson location B, north-east arm L. Timagami.	Quartz with finely disseminated pyrite.	5 lbs.	trace	.233 oz
Ferguson location C, Is'd in N. E. arm L. Timagami	Rust-stained sericite schist with pyrite.	15 oz.	trace	·116 oz.

The Denedus islands near the entrance to Muddy-water bay on Lake Timagami, and so-called after a well-known member of the Timagami band of Indians, is another mining location, owned by Mr. James Holditch of Sturgeon Falls. On the two large islands composing this group the rock is a dark greenish-grey feldspathic sandstone or greywacké, sometimes slaty in structure but usually massive. The rock is much broken up in places, and the irregular cracks and cavities thus formed are filled with grey translucent quartz, with which is usually associated more or less pinkish dolomite. Occasionally these fissures are so large as to include considerable masses of quartz. On the west island a quartz vein about two feet in width occurs, with a south-easterly strike, containing both iron and copper-pyrites. A somewhat larger segregated mass of quartz occurs on the island to the east, with similarly disseminated grains and fragments of iron, and copper-pyrites and occasionally a little galena. Assays of specimens from both these islands were made in the laboratory of the Survey with the following results†:—

Locality.	Description of Specimen.	Weight.	Gold per ton.	Silv per t
		lbs. oz.		
Denedus islands (east vein).	Quartz with a little chlorite and dolomite.	2 6	none	no
Denedus islands (west vein).	Quartz with chlorite chalcopyrite and pyrite.	3 6	none	no

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*Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, part R, analyses Nos. 69-71.

†Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, part R, analyses Nos. 79-80.

Large masses of iron-pyrites, associated with pyrrhotite, copper, pyrites and magnetite, occur on the east side of Timagami island in Lake Timagami and on the southeast shore of Vermilion lake, to the north of the northeast arm of Lake Timagami. Samples of these were assayed for gold and silver, but with negative results in both cases. Subsequently Mr. E. V. Wright, who had located the Vermilion Lake property, had the ore assayed for nickel, but less than one per cent of this metal was found. The following statement gives the results of the assays made*:—

Locality.	Description of Specimen.	Weight.		Gold per ton.	Silver per ton.
		lb.	oz.		
Timagami is'd. (east shore).	Pyrite, chalcopyrite, magnetite, with chlorite......	4	2	none	none
Vermilion lake	Pyrite in chlorite-schist and quartzite.		13	„	„

On Matthias island, about two miles northeast of the Hudson's Bay Co.'s post on Bear island in Lake Timagami, a quartz vein with a somewhat uniform width of about eight feet was noticed. The quartz is white and translucent, filled with rusty cavities and a little copper-pyrites, iron-pyrites, malachite and ankerite were noticed. Although so promising in appearance assays made in the laboratory of the Survey show neither gold nor silver.†

At the Guay mine, in rear of the township of Fabre, on the east side of Lake Timiskaming, according to Mr. J. Obalski of Quebec, a considerable amount of copper-pyrites has been found. This, associated with and disseminated through diabase, probably an extension eastward of the mass which reaches Lake Timiskaming at Quinn point, shows on assay according to Mr. Obalski, gold, .02 oz., and silver, 1·56 oz. per ton of 2,000 lbs.

Other specimens examined in the laboratory of the Survey during the progress of the exploration, from veins and masses of quartz that are of less importance either on account of the negative or small results obtained, or the limited extent of the masses themselves, are enumerated below*:—

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*Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, Part R, analyses Nos. 78 and 52.

†Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, Part R, analysis No. 53.

Locality.	Description of Specimen.	Weight.		Gold per ton.	Silver per ton
		lb.	oz.		
N. end of Lake Timagami..	Pyrite in quartz and calcite (from 10 ft. vein).		7¼	Trace.	None.
Little river, 1 mile E. Lake Timiskaming.	Greyish opaque quartz with a little pyrite.	2	10	None.	"
Point E. of outlet Hay lake, N.E. arm Lake Timagami	Quartz with a little chlorite and chalcopyrite.	1	14	Trace.	290 oz.
N. shore, N.E. arm, ¾ mile W. portage, Lake Timagami.	Quartz with traces of iron and copper.	1	3	None.	None.
Montreal river, 6 miles from mouth.	Red and white quartz with a little chalcopyrite.		14	Distinct trace.	"
E. shore Ferguson bay, Lake Timagami.	Calcite with a little chlorite and chalcopyrite.	1	11	None.	"
Small islet in Whitefish bay, Lake Timagami.	Quartz with pyrite in feldspathic sandstone.	4	3	Trace.	Trace.
Islet ¾ mile W. of Timagami post.	Quartz with a little dolomite and chlorite.		6	None.	None.
Two miles N.W. of Timagami post.	Quartz with chlorite and a little pyrite.		8½	"	"
Island near S. end S.W. arm Lake Timagami.	Rust-stained quartz with a little pyrite.	1		"	"
Mountain lake, Montreal river.	Rust-stained quartz with pyrite and chalcopyrite in diabase.	1	¼	Trace.	Trace.
Portage near S. end of Lake Timagami.	Quartz with chlorite and dolomite.	2	11	None.	None
Island 1¼ miles N.E. Timagami post.	Rust-stained quartz with a little ilmenite.	1	7	Trace.	"

Although the results given in the above tables are not very e couraging it must be remembered that the assays were made from material obtained during the progress of an exploration over a wid stretch of country in which only limited opportunities were afforded for examination and selection, while only those quartz masses were visited which were noticed exposed at or near the shores of lake embraced by the survey or in localities otherwise accessible. N systematic attempt has ever been made at prospecting throughout the greater portion of the district, although a few enterprising ind viduals have looked over part of the area in the hope of finding some unusually rich mineral deposit. A large portion of the area cover by the Huronian rocks in the northwestern part of the region i thickly covered by forest, composed chiefly of evergreens, which conceals much of the surface, rendering any attempt at prospecting difficult. The inaccessibility of the region has also generally prevented any extended examination by prospectors, but the recent survey of the Nipissing and James Bay railway, and the proposal to run this line northward from North Bay to the east end of Lake Timagami, has again drawn attention to this region as a promising mining field. The Huronian belt of rocks is the same that traverses the Sudbury mining district to the southwest, while similar associations of slate and greywacké broken through by diabase, gabbro and granitic intrusions, furnish conditions equally favourable to the presence of metalliferous sulphides or gold-bearing quartz-masses now known to exist in the vicinity of Wanapitei lake, immediately adjoining the Timiskaming sheet to the southwest.

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*Annual Report, Geol. Surv. Can., vol III. (N.S.), 1887-88, Part T, analysis No. 32.

†Annual Report, Geol. Surv. Can., vol. IV. (N.S.), 1888-89, Part R, analy Nos. 10, 72. 73, 75. 77, 65, 67, 68, 87, 81, 66.

One of the most important of the mineral deposits in this district, both on account of its comparative accessibility and the character and size of the ore-bearing body, is what has usually been known as the Lake Timiskaming silver or lead mine (Wright's mine) comprising portions of lots 61, 62 and 63 of range I., in the township of Duhamel, in what are called Blocks A and B, on the east shore of Lake Timiskaming.

Although this deposit was brought to notice by Mr. E. V. Wright of Ottawa in 1877, the existence of ore at this place was known long before, for on a "Map of North America,"* based on D'Anville's map, and published about 1778, the small bay on which it is situated is named "Anse à la Mine."

In the vicinity of the mine the rock is the breccia-conglomerate forming the basal member of the Huronian in this district, the pebbles or fragments of which are chiefly of granite, diabase or other eruptive rocks, embedded in a greenish, chloritic, slaty matrix which owing to pressure appears to curve around or enfold the enclosed fragments.

The deposit occurs in a brecciated or shattered belt of the rock composed of angular or subangular fragments, the interstices being filled by galena with occasionally a small quantity of iron-pyrites together with more or less pink dolomite. Although this zone is about eighty feet in breadth and contains a varying quantity of galena throughout, only about six feet can be said to carry the mineral in workable quantity, and even this with considerable admixture of gangue and rocky matter. The rock immediately adjoining and enclosing the deposit has a decidedly porphyritic appearance, crystals and fragments of white feldspar and grains of transparent quartz being embedded in a fine-grained greenish matrix. Under the microscope this fine-grained groundmass is seen to be composed of finely granulated quartz and feldspar, together with a considerable quantity of chlorite and sericite in fine scales. Through this are scattered the larger fragments which are apparent to the eye. Some ot these are composite fragments of some porphyritic rock, with large crystals of well striated plagioclase and finely granulated quartz. Whilst the majority of the quartz-fragments bear evidence of having been subjected to considerable pressure one large subangular grain extinguishes very evenly and shows little or no trace of disturbance. The plagioclase individuals have a broad tabular habit, are well striated, very turbid, and apparently constitute the predominant feldspar, although unstriated feldspar was observed. Ilmenite, accompanied by leucoxene, is rather plentiful; some of it is entirely altered to the latter mineral.

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*See Map No. 5, Mill's Report on Boundaries of Ontario, Toronto, 1873

Samples of the ore were sent to the Geological Survey in 1877, and Dr. B. J. Harrington states* that a specimen of the galena entirely free from gangue, gave, by scorification, silver 18·958 ounces to the ton of 2,000 lbs. Another specimen received about the same time, but containing a good deal of rocky matter, gave, silver 11·66 ounces to the ton, while a third specimen taken about fifty feet from the above gave, after careful separation of the gangue, silver 18·229 ounces to the ton. The mean of two assays by Dr. Hoffmann gave, silver 13·58 ounces to the ton with a trace of gold; by Prof. J. T. Donald, of Montreal, silver $21.17; by Dr. Baptie, of Ottawa, silver 23 ounces; by School of Mines, London, 13 oz. 14 dwt. 10 grs. per ton of 2,240 lbs. and lead 52 per cent. The percentage of silver in the galena itself was 26 oz. 7 dwt. 21 grs.

The silver content of the pure galena would, therefore, seem to vary from eighteen to twenty-four ounces to the ton of 2,000 lbs., but the large intermixture of rocky matter would considerably lessen these results. Iron-pyrites has been found intimately associated with the galena, and occasionally considerable quantities have been encountered in working the deposit. This is doubtless the source of the gold usually present in the ore.

Work was begun on this deposit in 1887, under the management and ownership of Mr. E. V. Wright, of Ottawa, but only preliminary development work was undertaken. During 1888, however, work was carried on very energetically, and a shaft was sunk to the depth of about 100 feet, while concentrating machinery was set up and it was proposed to smelt the ore on the spot. Various obstacles have stood in the way of the successful development of this mine, chief of which has always been its distance from railway communication and the consequent difficulties in shipment of ore or concentrates.

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*Report of Progress, Geol. Surv. Can., 1877-78, pp. 51-52.

For several years work went on in a rather desultory fashion, but in 1890 the Mattawa Mining and Smelting Co., of New York, took hold of the property and an extensive and costly plant for the proper handling of the ore was installed. The main shaft was increased in depth to over 100 feet, and two drifts were made to prove the extent of the deposit, while a diamond-drill boring carried to a farther depth of seventy-five feet proved the existence of the galena to a total depth of 140 feet. Operations were carried on energetically until March, 1891, when work was suspended. During the summer of 1896 work was again resumed, chiefly with a view of further testing the property, and it is hoped that the recent completion of the branch line of the Canadian Pacific railway to the foot of Lake Timiskaming may lead to continuous working. The main shaft is now sunk to a depth of nearly 200 feet, and it is reported the mineral shows no diminution in either quantity or silver content.

Nickel, Copper, Etc.

The Huronian belt of rocks, characterized by the presence of great deposits of nickelferous and cupriferous ores in the Sudbury district, runs with unbroken continuity through the Timagami and Timiskaming districts. Diabases and gabbros apparently identical in their composition and appearance are present over large areas, but so far no very large deposits of pyrrhotite and copper-pyrites have been found. On the west side of Timagami island, as well as on the southeast shore of Vermilion lake, considerable masses of these sulphides are present, but the assays made show only a very small percentage of nickel. Copper-pyrites is an almost invariable constituent of the diabasic masses and in places pyrrhotite is equally abundant, and it is highly probable that systematic prospecting may develop large deposits containing nickel and copper.

At the Guay mine, in the rear of the township of Fabre, the specimens of copper-pyrites gave, according to Mr. Obalski, 0·72 per cent of copper, and ·08 per cent of nickel.

The inaccessibility of the region, however, and the abundance of these nickel and copper bearing sulphides in close proximity to the main line of the Canadian Pacific railway, in the Sudbury mining district, many excellent deposits of which have not yet been developed, prevent any extended search in the Timagami and the Timiskaming districts.

Iron.

No deposits of iron ore of economic importance have as yet been found in this district, although both magnetite and hematite are rather abundantly distributed. Wherever noticed the quantity has been too insignificant or the associations such that the material seen could not be utilized with any degree of profit. Magnetite occurs in patches and small masses in the red granitoid-gneiss exposed in the neighbourhood of the Chute des Paresseux on the Mattawa, in the township of Olrig. On the west side of Kipawa lake, a short distance northwest of Gordon Creek outlet, a dark-grey gneiss containing a considerable proportion of magnetic iron ore occurs, and a quantity of this ore was mined and taken to the Wright mine on Lake Timiskaming for use as a flux in the smelting of the galena. The ore, however, is too lean and siliceous to be of commercial importance.

On Iron island, according to Mr. Murray,* "small masses of specular iron ore are common to most of the rock in the island, and in the crystalline limestone there is a very great display of it. For a breadth of about forty yards along the cliff on the east side the rock holds masses of the ore of various sizes, sometimes running in strings of an inch thick or upwards, elsewhere and at other times accumulating in huge lumps, some of which probably weigh over half a ton. The beach near the outcrop is strewed with masses of all sizes, from great boulders weighing several hundred pounds to small rounded pebbles not bigger than marbles. The limestone with which the iron-ore is associated is frequently cavernous, and the crevices and smaller fissures are thickly lined with crystals of blue fluorspar and red sulphate of barytes or cockscomb-spar. Crystalline limestone crops out on the opposite or west side of the island, and judging by the strike of the north side it must correspond with that holding the iron-ore on the east. The same minerals were found disseminated through the rock and strewed upon the beach. At the extreme southwest point of the island the rock is again crystalline limestone, and a long beach running out from it to the westward is perfectly covered with boulders of specular iron-ore. Iron-ore occurs also at the southeast point of the island, although not in such great abundance and only in detached masses strewed upon the beach."

Several parties have searched rather thoroughly over this island and most, if not all, of the iron has been carried off and shipped away. The interior of the island is a veritable jungle, and the shore is lined with an almost impenetrable thicket of scrubby cedar.

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*Report of Progress, Geol. Surv. Can., 1853-56, p. 123.

Several small pits were noticed which had been sunk near the northeast corner of the island, but the amount of ore secured apparently did not warrant any further outlay of time or money, and it seems pretty certain that this ore is nowhere present in workable quantity. At the time of the writer's visit early in the spring most of the beach was submerged.

Magnetic iron-ore, interlaminated with bands of red, grey or black, siliceous, slaty rock was noticed in several localities, and in such considerable quantity as to constitute deposits of workable size, but the abundance of intermixed siliceous matter is probably such as to render them practically valueless. One of these deposits is situated on the southeastern end of a group of three islands near the eastern shore, about three miles from the southern extremity of the southwest arm of Lake Timagami. The exposure seen consisted of alternate bands of light and dark-grey quartzite, the dark bands being composed almost wholly of grains of magnetite. It is curiously contorted, but has in general a dip N. 7° E. < 45°. In immediate contact with this to the south is a band of disintegrating greywacké and chlorite schist, dipping N. 9° E. < 55°. This is filled with pyrite, which has evidently been the chief cause of its decomposition. The local attraction of the magnetic needle was so great at this point as to render the compass practically useless.

Near the west end of Turtle lake, to the north of the northeast arm of Lake Timagami, there is a somewhat similar deposit, consisting of alternating reddish and black bands of hematite or jaspery iron ore and magnetite, with some olive-green shale. The strike of the deposit accords with that of the sericite-schists in the immediate vicinity, being N. 74° E. with a dip northwards < 70. In this neighbourhood, also, the compass was much affected.

A third locality in which magnetite in similar association occurs is on the Quinze river, on the tenth portage from Lake Timiskaming. Mr. W. McOuat thus describes the deposit: *"The portage is on the south, or left hand side of the river, running in a direction about southeast to a small lake in a narrow ravine, and is not more than a quarter of a mile long. The iron ore crosses the portage near the upper or south end. It occurs in the form of layers from the thickness of paper to about an inch, and is interlaminated with similar layers of whitish, grey and dull-red fine-grained quartzite. The iron-ore constitutes probably from a fourth to a third of the whole, and as the thickness of the whole band is about thirty feet the whole thickness of the layers of iron ore would probably not be

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*Report of Progress, Geol. Surv. Ca[illegible] 1872-73, pp. [illegible] less than eight feet. The band was traced along the strike for about a hundred yards. Magnetic oxide of iron was observed under similar conditions at several points on this portage, and on the next above, but in much smaller quantity."

Magnetic iron ore also occurs, but mixed with sulphides, on the southeast shore of Vermilion lake and on the east shore of Timagami island, in Timagami lake. Hematite (as micaceous iron ore) occurs as a rather common constituent of the many quartz veins cutting the Huronian throughout the northern part of the area, but it has nowhere been found in deposits of sufficient extent to be of economic value.

Although of no economic importance it will be of interest in this connexion to record the presence of native iron embedded in the crevices of some specimens collected on Mr. McMeikin's farm, about four and a half miles east of Mattawa. This occurrence of native iron, to which Dr. Hoffman's attention was first drawn by Mr. R. L. Broadbent, was detected in some specimens collected as samples of perthite and amazonite [illegible] of the township of Cameron. The following description is given by Dr. Hoffman:

*"The perthite consisting of interlaminated brownish-red to reddish-brown orthoclase and reddish-white albite, contained here and there inclusions of greyish black, massive, pebbly magnetite, partially altered manganiferous magnetite, affording a dark-reddish-brown streak.

"Portions of the feldspar showed marked signs of weathering, the albite more especially being more or less kaolinized. Embedded in the kaolin, also in the dark reddish-brown limonite in immediate proximity to it, were observable numerous spherules of a steel-grey colour and metallic lustre. These spherules varied greatly in size, a few measuring as much as a millimetre in diameter, the greater number, however, being of far smaller dimensions, and many of microscopic minuteness. They were almost perfectly spherical in shape, strongly magnetic, very hard, indenting and scratching a hardened steel mortar; brittle; when pulverized emit a distinct phosphoretted odour; immersed in a solution of cupric sulphate become coated with a film of metallic copper. They were readily attacked by hydrochloric acid with evolution of hydrogen and a strong odour of phosphine, leaving an insoluble residue consisting of light brownish coloured spherules which on ignition become perfectly white. These spherules, which form the nuclei of the metallic looking grains, have apparently a concretionary structure.

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*Annual Report, Geol. Surv. Can., Vol. VI. (N.S.), 1892-93, p. 23 R

"Mr. Johnston found the metallic spherules to have a specific gravity at 15·5° C. of 7·257 and a composition as follows:—

Iron	90·45
Manganese	0·75
Nickel	trace
Sulphur Phosphorus Organic matter	undet.
Insoluble, non-metallic, residue	7·22
	98·46

"Cobalt and copper were sought for and found to be absent. He found the insoluble non-metallic residue to contain 88·77 per cent of silica, a little alumina and ferric oxide—not estimated, a very small quantity of lime and possibly some magnesia.

"This occurrence recalls to mind that observed by me in a specimen of Huronian quartzite from the north shore of St. Joseph island, Lake Huron, Ont." *

Limestone and Lime.

On Lake Timiskaming the Niagara formation so abundantly exposed on the islands and shores of its northern portion affords an unfailing supply of excellent building stone, in blocks of large dimensions if required, while its fine and even texture as well as its colour recommend it strongly for such purposes. The Anglican church at Haileybury, on the west side of Lake Timiskaming, is being wholly constructed of material procured from exposures of this limestone on the east shore of Mann island. For purposes of making quicklime the more thinly bedded fossiliferous portions seems to be most suitable as furnishing the purest and best lime with least expenditure of fuel.

The Manitou islands, in Lake Nipissing, especially McDonald or Little Manitou island, have furnished limestone which was used to advantage during the construction of the Canadian Pacific railway. An excellent lime-kiln was noticed on McDonald island, which had evidently been used extensively. To the east of Mattawa, and between this place and Deux Rivières, a good deal of lime has been manufactured for local consumption, as also near the foot of Talon lake on the Mattawa river. In the former instance the various outliers of Trenton limestone have supplied the material, while in the latter a band of crystalline limestone has been made use of by the incoming settlers. This band of limestone would furnish a very pretty serpentine marble or ophicalcite.

When calcined the deposit of marl covering the greater portion of the bottom of Emerald lake to the west of the Opimika narrows on Lake Timiskaming would furnish a nearly pure and very white lime well adapted for mortar and other purposes. For such purposes the marl should be moulded into bricks which, after drying, may be burnt in a kiln. It might also be employed for whitewashing farm and other buildings.

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*Trans. Royal Soc. Can., vol. VIII., sect. III., p. 39, 1890

Granite and Gneiss.

During the construction of the Canadian Pacific railway the greyish evenly foliated gneissic rocks, often easily procurable in large blocks, were used for bridge-piers and culvert work with satisfactory results. Many exposures capable of yielding both gneiss and granite of excellent quality may be found at intervals along the line of railway.

On Timiskaming lake, in the vicinity of Baie des Pères, there is a very beautiful deep flesh-red granite, in which the more or less rounded outlines of the disseminated grains and fragments of greyish translucent quartz give the rock a fine conglomeratic or prophyritic aspect. It is not known, however, whether this granite can be obtained sufficiently free from joints.

Throughout the entire area the frequent and large masses of granite exposed, as well as the more massive and granitoid portion of the rocks classified as Laurentian, would furnish building stones of good quality, but only the more readily accessible localities of such rocks can be supposed to possess any importance.

Flagstones and Slates.

The better qualities of slate do not occur extensively in this region, but some portions of the strata constituting the slaty or middle member of the Huronian present very fine-grained and fissile beds which are firm and strong; although most of the specimens seen are rather thick for roofing purposes. Search might reveal some localities where suitable material occurs in sufficient abundance to be of economic importance. Many portions would, however, seem to be well adapted for flagging.

On the east side of Lake Timiskaming, between McMartin point and Latour's mills, the shore-line for several miles is formed of vertical cliffs of very evenly banded or foliated micaceous gneiss. The layers are extremely regular, fissile and of suitable thickness to yield flagstones of the very best quality and of almost any size.

Lithographic Stone.

Some of the finer-grained beds present in the Niagara outlier on Lake Timiskaming, exposed on Mann island as well as at Dawson point on the mainland to the north, exhibit portions which were thought to be suitable for lithographic purposes. Some quarrying was done on the west shore of Mann island, and lately a company with headquarters at Vankleek Hill commenced operations in the vicinity of Dawson point with a view to securing suitable material if possible. So far, however, the specimens procured are not sufficiently uniform in texture, but it is still possible that lithographic stone of economic value may be discovered. Further examination of these beds with this object seems desirable.

Feldspar.

Although this mineral is abundantly distributed as one of the most important and characteristic constituents of these crystalline rocks, only a very small proportion is found pure enough and in sufficiently large masses to be employed for industrial purposes. To be of value the deposits must be readily accessible, and must contain the mineral in large cleavable masses easily freed from other associated minerals or impurities by a rough cobbing before shipment.

There are many large pegmatite dikes close to the line of the Canadian Pacific railway throughout this district, which might be examined with a view to obtaining supplies of feldspar. Some of those near Nasbonsing station seemed to furnish abundant and very suitable material.

Feldspar is chiefly employed in the manufacture of porcelain and pottery.

Shell Marl.

Deposits of this kind are frequently found below accumulations of peat, the marl in these instances being, therefore, of not very recent formation, but in other cases it is found to be still in process of deposition, covering the bottoms of shallow ponds or lakes.

Emerald lake, about five miles west of the Opimika narrows, is at the headwaters of one of the branches of Opimika creek, which reaches Lake Timiskaming from the west immediately above the Opimika narrows. This creek and the lakes which it empties are remarkable for their clear water. Emerald lake itself is comparatively insignificant in size, being only about half a mile in length, by a quarter of a mile in greatest width at the southern end, gradually tapering towards its outlet at the northern extremity. The lake is in a small valley from eighty to one hundred feet in depth. At the southeast corner is a very shallow bay, affording entrance to a stream which is fed by a number of large cold springs that rise at the base of an amphitheatre-like gully, at the base of steep banks composed mainly of sand and gravel. The water of the bay, although so shallow, is very cold even during the hottest days of summer, while the whole bottom is covered with a deposit of shell marl of unknown depth. That this depth is considerable there is no reason to doubt, as the soundings made with long poles failed to reach the bottom of the deposit. Besides this bay the whole lake contains marl deposited on the bottom, while the pebbles and boulders near the outlet show a considerable coating of this loosely coherent, earthy carbonate of lime. The water of these springs is evidently calcareous and is found to be slightly aperient.

According to Mr. J. F. Whiteaves, who has examined the specimens of fresh water shells obtained from this locality, the species represented are *Sphærium sulcatum* (Lam.), and *Planorbis trivolvis* (Say) var. *macrostomus* (Whiteaves).

A sample of the marl examined in the laboratory of the Survey was found to have the following composition*:—

Hygroscopic water (after drying at 100° C.)	1·06	per cent.
Lime	48·32	"
Magnesia	0·04	"
Alumina	0·07	"
Ferric oxide	0·08	"
Manganous oxide	Traces	
Potassa	Traces	
Soda	Traces	
Carbonic acid	38·01	"
Sulphuric acid	0·07	"
Phosphoric acid	0·02	"
Silica, soluble	0·10	"
Insoluble mineral matter	8·62	"
Organic matter, viz.: vegetable fibre in a state of decay, and products of its decay, such as humus, humic acid, etc., and possibly a little combined water	4·79	"
	100·12	

"Assuming the whole of the lime to be present in the form of carbonate, trifling quantities of which are, however, present in other forms of combination, the amount found would correspond to 86·2 per cent of carbonate of lime. The insoluble mineral matter was found to consist of":—

Silica	6·24	per cent.
Alumina and ferric oxide	1·51	"
Lime	0·29	"
Magnesia	0·08	"
Alkalies (?)	0·50	"
Total	8·62	

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*Annual Report, Geol. Surv. Can., vol. VII. (N.S.), 1894, p. 31 R

Marl is often used as a fertilizer, and deposits such as that exposed at Emerald lake should be of value locally for this purpose.

Grindstones and Whetstones.

Some of the material contained in portions of the beds of coarse sandstone and grit found near the base of several of the Palæozoic outliers would probably be suitable for the purpose of making grindstones. A quarry was opened many years ago on one of these arenaceous beds exposed above Deux Rivières, which furnished some excellent grindstones. Where the layers are not thick enough for this purpose they would furnish whetstones of a very fair quality. Where too hard and compact these stones answer only for a short time, when first used, soon becoming too much polished.

Portions of the very fine-grained, banded slates and greywacké's so frequently met with throughout the northern and northeastern part of the district may probably afford material suitable for hones and whetstones.

Clay for Bricks and Earthenware.

Clay suitable for the manufacture of bricks extends over a very large area in the northern part of Lake Timiskaming, from the vicinity of the combined mouths of the Montreal and Matabitchouan rivers, northwards far beyond the confines of the present map. The bricks for the large convent and church built by the missionaries of the Oblat order at Baie des Pères were made there. In the vicinity of North Bay, and extending thence some distance beyond Verne, brick clay is readily accessible, although sometimes concealed by the presence at the surface of varying thickness of yellow sand. A brick-yard was in successful operation at North Bay for some years, and if the local demand were sufficient it would no doubt be re-opened. Some of these beds of clay might also furnish material applicable for the manufacture of coarse earthenware, but so far no clays fit for the finer kinds of pottery have been found in this region.

Mica.

Both biotite and muscovite are among the commonest constituents of the various Laurentian gneissic rocks, but although thus widely distributed their presence in this association is not of economic importance. The numerous and often large pegmatite dikes that cut these Laurentian rocks give promise, in places, of affording a supply of mica in sheets sufficiently large and in such quantities as to be available for economic purposes. The southern portion of the township of Calvin is perhaps the most important of these localities, but so far the muscovite obtained, representing the material exposed at or near the surface, has been too inferior in quality to command a price commensurate with the cost of mining. The opening up, however, of a large portion of the southeastern portion of the area of the Lake Nipissing sheet for settlement, may bring to light other masses of pegmatite producing good mica.

Asbestus.

This mineral has been found in the district. One of these localities is situated near the west shore of the "Mattawapika" on Lady Evelyn lake, on the Haycock mining location. It is also known to occur in the northeast of Baie des Pères, but the deposits thus far discovered are not very extensive.

Graphite.

This mineral, so abundant in the Laurentian area farther to the southeast, is of rather rare occurrence in the region under description, and although doubtless present as an occasional constituent of some of the gneissic rocks its presence was only noticed at one locality, where it occurs disseminated in minute grains and scales throughout the biotite-cyanite-gneiss exposed near the shores of the Ottawa in the vicinity of Les Erables rapids and Snake creek. Its presence in a rock-mass has often been referred to as evidence of its sedimentary origin, but in this instance there seems to be no doubt whatever that the rock containing it is a rather unusual phase of the biotite-gneiss, and as such is to be considered as a foliated plutonic mass.

Apatite.

This mineral, though abundant as an accessory or accidental constituent of many of the crystalline rocks occurring in this region, has not yet been found in deposits possessing any commercial value. The only locality where it was noticed in such quantity as to be recognizable without the aid of the microscope is on the property of Mr. Emery Racicot, on lot 4, con. VI., of the township of Ferris, a short distance from Nasbonsing, a flag station on the Canadian Pacific railway. A pegmatite dike is here exposed, composed chiefly of very pure and coarsely cleavable flesh-red orthoclase, with which is associated a much smaller quantity of black biotite often in large cleavable fragments. The dike is about six feet in width, has direction a little west of north, according with the foliation of the garnetiferous hornblende-gneiss with which it is associated. The apatite occurs very sparingly, generally in small well developed prismatic crystals embedded chiefly in the biotite. Some of the crystals noticed presented the following combination of faces: $\infty P.\ P.\ 0P.\ \infty P2.$ Most of the crystals were too fragile on account of their long exposure to admit of their being liberated without breaking from the material in which they were enclosed. The feldspar in this and other dikes in the near vicinity is very pure, and large pieces, many pounds in weight, could be readily secured without any admixture of foreign matter.

Fluorite.

Fluorite or flour-spar is found in large cleavable masses, associated with orthoclase, microcline and perthite, in the large pegmatite dikes that cut the biotite-gneisses in the township of Cameron, about four miles and a half east of Mattawa. The fluorite is of a light-greenish colour, but, like the feldspathic constituents of these dikes, is very much stained and infiltrated with ferric hydrate, which fills the numerous cracks and fissures present in the mineral.

Molybdenite.

The presence of this mineral as an occasional constituent of quartz veins has been noticed in this district immediately surrounding Lake Nipissing. It is stated to occur in considerable quantity to the north of Talon creek, on the Mattawa river, although its presence there was not verified during the progress of the examination of the region.

Steatite.

This mineral, usually a decomposition product of basic pyroxenic or hornblendic rocks, is not very commonly met with, but specimens were obtained of tolerably pure material from the west shore of Lake Timiskaming, about four miles south of the Montreal river.

Amazon-stone and Perthite.

These two minerals are intimately associated with one another, constituting much of the feldspathic constituents of some pegmatites which cut a readily disintegrating biotite-gneiss that outcrops on lot 7, con. B, of the township of Cameron, about four miles and a half east of Mattawa. Four openings have been made of the nature of small pits or shallow trenches, extending only a few feet below the surface. The largest dike is about five feet in greatest width, running northeast and southwest. The railway line is about 200 yards to the north, while the Ottawa river passes about 500 yards to the south of the exposure. The openings were made for apatite, and work on the property was abandoned when this material was not found. The amazon-stone when fresh is of a very beautiful deep bluish-green colour, but owing to its proximity to the surface much of the material is more or less stained, and the minute crevices are filled with ochre. This defect would doubtless soon disappear in depth. Some of the material secured at the insignificant depth reached by the present workings is remarkably good, and is suitable for cutting and polishing.

The perthite, which is intimately associated with the amazon-stone at this locality, is a pale flesh-red aventurine feldspar, shown to consist of a fine interlamination or parallel intergrowth of albite and orthoclase. The alteration of the darker-coloured flesh-red orthoclase with the paler albite, and the accompanying brilliant aventurine reflections, produce a beautiful stone when cut and polished.

Cyanite.

The occurrence of this mineral *in situ* in Canada was first noticed by the writer in 1890, in a cutting on the main line of the Canadian Pacific railway, about half a mile east of Wanapitei station. Here it occurs in flattened blade-like crystals and fragments, in association with a reddish almandine garnet in a mica-diorite-gneiss. The crystals usually conform to the foliation, but sometimes they occur in groups and clusters disposed at varying angles to the schistosity. In the more basic portions of the gneiss the crystals are darker in colour, and have undergone in places rather extensive cracking and deformation as a result of pressure. In the more acid or pegmatitic portions of the rock the cyanite is much lighter in colour and occurs in stouter prisms. Fibrolite (sillimanite) also occurs in this locality, developed chiefly along certain crevices in the gneiss. It is fibrous or finely columnar in structure, and is traversed at right angles to the fibres by numerous fine cracks. Sometimes it occurs in curious irregularly radiating or plumose aggregates. The colour when fresh is of a pale bluish-grey.

During the examination of the Ottawa river above Mattawa cyanite was again noticed as a constituent of the biotite-gneiss exposed in the cuttings on the Timiskaming branch of the Canadian Pacific railway in the vicinity of Les Erables rapid and Snake creek. Here also it occurs in long, thin-bladed crystals in association with red garnet, and is in many places so abundant a constituent of the gneiss as to characterize this rock. The crystals are usually light-bluish or greenish, but some show a beautiful deep azure-blue centre with white margins.

Fossil Corals.

The particularly fine fossil corals of the Niagara outlier exposed on the shores and islands of the northern portion of Lake Timiskaming, which have undergone in most cases complete silicification, would doubtless not only command a ready, though somewhat limited, sale as specimens, but when polished would form an attractive ornamental stone for certain purposes. The west side of Mann island exhibits abundant specimens of this kind.

Springs.

The region, as a whole, is not characterized by abundant springs, although occasionally some large ones are encountered. Opimika creek, reaching Lake Timiskaming from the west immediately north of the narrows of the same name, is chiefly fed by springs, as is also Latour creek, which enters the same lake on the west side about four miles above the Old Fort narrows. Both these streams are remarkable for the coldness and clearness of their waters, and for the fine specimens of brook trout to be found in them. A fine large spring rushes down the hill immediately behind Thompson bay, below the Opimika narrows, on the east side of Lake Timiskaming, about half a mile east of the old Hudson's Bay Co.'s post. Another spring of good water flows down at the head of Les Erables rapids on the Ottawa. As the country becomes settled many new springs will be found, but the abundance of good water contained in the many lakes and streams of the region renders the presence of springs much less important, although as a rule the water in these lakes is rather warm for drinking purposes during the summer months. During a considerable portion of the summer the presence of a large number of minute greenish or yellowish particles, often so abundant as to form a scum at the surface or around the margins of the lakes, renders the water of many of them more or less unfit for drinking purposes. The waters of the springs that feed Emerald lake, at the head of one of the branches of Opimika creek, have already been referred to. They are the only ones known to possess therapeutic qualities.

REGIONAL DESCRIPTION.

The Ottawa river and Lake Timiskaming.

General Features.

As may be seen by a reference to the accompanying map-sheets, a considerable length of the Ottawa is included by them. From the northeast bay of Lac des Quinze where it enters the Lake Timiskaming sheet, to the mouth of the Mattawa (which for convenience has been included in the southern sheet) the distance is about 142 miles. Three large lakes occur in this distance, which may be regarded simply as expansions of the stream.

The most northern of these expansions, known as Lac des Quinze, is very irregular in outline, with several long arms or bays running in various directions, but the most direct line of communication through the lake measures about twenty-two miles. This lake is separated from Lake Timiskaming by a short stretch of water known locally as the "Quinze river," noted for its wild and dangerous rapids, and which in its eighteen miles of length falls a distance of two hundred and sixty feet. Lake Timiskaming, into which this stream empties, is sixty-seven miles long from the mouth of the Quinze to the head of the Long Sault rapids, while Seven-league lake, which commences at the foot of these rapids, adds a further length of seventeen miles. While it would thus appear that the river, strictly speaking, embraces only about thirty-eight miles of this whole distance, it may be stated that a considerable proportion of that generally included as lake should in reality be considered as portions of the river proper. A large part of these water-stretches exceeds but very little, if at all, the average width assumed by the river when not obstructed by rapids, while at several points a swift current is present, denoting a small though appreciable change of level.

Thus Seven-league lake, in its lower portion, is only about a quarter of a mile wide, while in the upper part it never exceeds half a mile. In this lake a light current can usually be detected, showing a total fall in the whole length of about a foot during the ordinary low water of summer; but during times of freshet this current is augmented, and the total fall is increased to a little over two feet.

Lake Timiskaming itself, as noted in the appendix, shows a difference in level of a foot from the head of the Long Sault rapids to the wide portion above the Old Fort narrows, while the lower portion of the lake south of the mouth of the Montreal river is quite river-like. This difference in level is maintained by three very pronounced contractions. The most northerly of these is at the Old Fort narrows, where the lake is pinched in between two bold hills of gravel, leaving a channel a little less than 800 feet wide at ordinary stages of the water. At the Opimika narrows, about thirty-five miles farther, a still more pronounced current flows through a strait which at one place is less than 200 yards in width. This current, formerly known to the old voyageurs as "La Gabrè," shows a descent of fully half a foot. At Presquîle, about a mile north of the head of the Long Sault, the third contraction occurs, and here again a considerable current may be noticed, but not so strong as at the Opimika.

The Ottawa, from the northeast bay of Lake des Quinze, has a general direction of a few degrees south of west as far as the head of Lake Timiskaming. At this point, however, it suddenly changes, and from the head of this lake, as far as the mouth of the Mattawa river, the stream flows about S. 30° E. In places there is a decided divergence from this general course, caused by local bends, which are especially characteristic of the upper portion of the river, but from Lake Timiskaming to the Mattawa the river follows an unusually uniform and deep valley, and any bends which do occur are in the nature of large curves.

The upper part of the river above Lake Timiskaming occupies a very pronounced valley, and the hills around Lac des Quinze present the usual rounded or dome-like outlines so distinctive of areas underlain by the Archæan gneissic rocks. Except on the northern portion of the lake, where they are unusually bold, ranging from 200 to 300 feet in height, the hills are as a rule low, averaging less than 100 feet. The Quinze river, which usually breaks across the strike of the enclosing rocks, occupies an original, but not very pronounced, depression. When Timiskaming is reached these conditions undergo a decided change; and the valley, especially in the lower portion, is fiord-like in aspect. From the Mountain rapid to the mouth of the Mattawa the river breaks across irregular ranges of hills, which rise very abruptly from the water to heights of from 400 to 600 feet, while the shores on either side of Seven League lake, which are as a rule bold and rocky, preserve a rather constant elevation of from 200 to 300 feet. In the construction of the Lake Timiskaming branch of the Canadian Pacific railway along the rocky eastern bank this was so steep and abrupt that it was found necessary in most instances to make large rock-cuts, the road skirting the shore.

From the mouth of the Montreal river to the Long Sault rapids the banks on both sides of Lake Timiskaming are extremely bold, and, as a rule, rocky, and frequently for several miles present unbroken cliffs. The hills on both the Ontario and Quebec sides of the lake rise very steeply from 350 to 600 feet, with but few minor and unimportant breaks where some of the larger streams flow in. Throughout the whole of the distance from Mattawa the tributary streams all show a very abrupt descent to this valley. Above the mouth of the Montreal the topographical outline changes somewhat suddenly, and the shore, though still in many places steep and abrupt, is not continuously so; while wide and open valleys covered with drift separate the still high hills. The west shore of the lake is especially steep and regular, and until Haileybury is reached no flat of any appreciable extent occurs. Near the northwest corner of the lake large and comparatively level tracts exist that extend far beyond the boundaries of the accompanying map, and are fast being opened up for settlement.

The eastern, or Quebec shore, presents many deep and important indentations, and although numerous high and exceedingly rugged hills occur, they are for the most part separated from one another by flats of clay. These have in many instances been cleared and are at present occupied by prosperous farmers, the soil being good and yielding abundant crops.

The depression occupied by Lake Timiskaming extends in a northwesterly direction, but becomes divided into two subsidiary valleys by the flat limestone promontory terminating in Dawson point. These valleys are occupied by the two important tributaries known as W[illegible] creek and the Blanche (or White) river.

It has always been known that the Ottawa river is, in many portions of its course, very deep, but no accurate information regarding its depth was published until Mr. Thos. Guerin, C.E., examined that part of the river above Mattawa.* Those soundings were, however, few in number and confined chiefly to Seven League lake, although a few were obtained in the vicinity of Chief island on Lake Timiskaming. Mr. Guerin states that Seven League lake was sounded in several places, the depth obtained being generally about sixty feet. In one place it was 397 feet, but in no place was it found to be less than thirty feet deep. The sounding-line on Lake Timiskaming was unfortunately only 120 feet long, and on continuing the soundings south of Chief island it soon failed to reach the bottom.

During the progress of the geological survey several calm moonlight nights were spent in sounding Lake Timiskaming. These soundings were commenced at the Opimika narrows where the deepest water was found to occur in close proximity to the western shore which is here steep and rocky. The bottom is composed of coarse gravel and boulders, and the lead showed a narrow and tortuous channel whose greatest depth was forty-five feet.

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*Annual Report, Minister of Public Works, 1884-85, pp. 106-107.

Four more soundings were taken in going north, in the next mile, showing a gradual deepening with a gravelly and ultimately a sandy bottom. These soundings were respectively 55, 47, 75 and 111 feet. About midway between Main Channel islet and the west shore the channel is sixty-five feet deep, while that between this island and the eastern shore is only fifty-five feet. It is evident that there exists at this point a considerable bar, due to the deposition of morainic or drift material, of which Main Channel islet (wholly composed of boulders) forms the culminating point.

From this place to within half a mile of McMartin point three soundings were taken, showing an increase first to 95 feet, then 139 feet and 183 feet, while three soundings taken at this point showed 211 feet in mid-channel, and 198 and 127 feet, the latter being within 200 yards of the western shore. Opposite McMartin point the lake again appears to shallow somewhat, and the deepest sounding near the centre was 157 feet, while half way between this and the western shore it shallows still further to 130 feet. Again it would seem that this shallow portion is caused by an accumulation of morainic *débris*, of which McMartin point forms the shoreward extension.

All of the above soundings showed a bottom composed of very fine gravel or sand. To the north of McMartin point the lake deepens rapidly and maintains a very uniform depth as far as the mouth of the Kipawa river. About a mile north of McMartin point the depth noted was 425 feet, while still farther north, opposite Latour's mills, in mid-stream, the depth found was 460 feet. This great depth was maintained close to either shore, for a sounding taken within ten chains of the western shore showed 455 feet, while one taken an equal distance from the eastern shore was 320 feet. About a mile farther north the lake is 423 feet deep and again in mid-channel opposite the Buffalo rock it is 430 feet deep. The deepest sounding made was taken a little over a mile south of the Kipawa river, about the middle of the lake, the depth being 470 feet. Going northward the lake shallows, and opposite the mouth of the Kipawa is only 362 feet deep. Throughout this interval of great depth, from McMartin point northward, the whole bottom was found to be covered by a soft, unctuous, grey clay or ooze into which the lead sank a foot or more.

The depth ascertained at the mouth of the Kipawa remains uniform to within a mile of the combined mouths of the Montreal and Matabitchouan rivers, where it is 347 feet. Northward the lake gradually shallows, and opposite the mouths of these streams has been partly filled up by an extensive deposit of sand and gravel that forms the bottom in this neighbourhood. These streams cannot, however, account for the vast accumulation of loose material which is here evidently present, for the lake is over a mile wide, and for more than a mile in length has been filled up by a deposit varying from 100 to 150 feet in depth. Farther, the lake shallows considerably to the north of these streams, while the reverse would have been the case if the whole of the material had been brought down by them. This extensive bar has probably been deposited in the first place as a lateral moraine in the shelter of the bay in the rocky hills that occur at the mouths of these rivers, while the material subsequently transported and laid down by the streams has reformed and modified these deposits, producing the somewhat wide delta now found.

Opposite the mouth of the Montreal river the depth of the lake in the middle is 275 feet, while about three-quarters of a mile farther north this again decreased to 256 feet. Still farther north the lake deepens rapidly, and two miles north of the Montreal river the soundings showed a somewhat uniform depth of 400 feet. A little over half a mile southeast of Roche McLean the lake is 378 feet deep, while opposite the north end of Quinn point it is 370 feet. Here again a bar composed of boulders and clay with a little sand extends from the northeast end of this point for nearly a quarter of a mile, with only about five feet of water at ordinary summer level. In the centre of the large open space to the north of Quinn point the lake is 348 feet deep, while in the middle of the Narrows, opposite Pointe à la Barbe, it is only 170 feet deep. In the open space opposite the mouth of the Little river it is 175 feet deep, thus showing a rather uniform depth in this position.

The Old Fort narrows is a very decided contraction occasioned by two bold hills of sand, gravel and boulders. The deposition of the material at this point was evidently determined by a pre-existing rocky narrows, the higher portions of which may be seen protruding from the surrounding mantle of sand and gravel. During the retirement of the ice-sheet up the valley of the lake a large amount of morainic material was deposited at this place, thus still further reducing the channel. In the channel, immediately opposite the Hudson's Bay Co.'s old store, the first sounding showed a depth of thirty-one feet, which was gradually increased to about seventy-five yards from the west shore; while less than thirty yards from the west shore the depth was found to be forty-six feet. To the north the lake gradually deepens, first to eighty-eight feet about an eighth of a mile north of the Narrows, and finally to 120 feet about half a mile north. In the opposite direction, or southwards, on the other hand, the lake deepens first to sixty-five and then to 130 feet within less than an eighth of a mile.

There seems, therefore, to be no warrant for the supposition that this barrier of sand, gravel and boulders extended at one time completely across the lake, for, if such had been the case, it appears probable that the removal of this material would have resulted in the accumulation of a considerable deposit immediately south of the Narrows, which is not found, as the descent on the south side is much steeper, in fact nearly as steep as the angle of repose, under the conditions, for gravel and sand.

Our soundings did not extend farther to the north, and although the western shore-line is still very steep and abrupt it is not probable that the great depth characteristic of those areas to the south of the Narrows is maintained in this direction, although occasional localities with considerable depth may doubtless be found, presumably in the neighbourhood of the western shore.

The highest water in this part of the Ottawa is in general occasioned by the melting of the snow in spring, and occurs usually about the latter part of May, while the time of low-water is during September or October, according to the setting in of the autumn rains. During the summer months the Ottawa is remarkably and quickly affected by very heavy or long continued rainfalls. In ordinary seasons the difference in level varies from twelve to fourteen feet, but in 1887, and again in 1894, Lake Timiskaming and this portion of the Ottawa showed the astonishing difference of twenty-one feet between the two extremes of high-and low-water. Both of these years were, [illegible] remarkable for an extremely heavy snowfall during the preceding winter, thus furnishing conditions for an extraordinary spring freshet, while the succeeding summers were notable for excessive and long continued drought, and the lowest water occurred during the month of September.

One of the most marked effects occasioned by this difference in level is the corresponding difference in the fall of the Long Sault rapids that separate Lake Timiskaming from Seven League lake, and the accompanying increase in the fall of the rapid at the outlet of the latter, known as "The Mountain." During times of low water the fall in the Long Sault rapids is almost fifty-five feet, while at high-water it is only forty-nine feet. On the other hand, during times of freshet, the Mountain rapid has a fall of seven feet, while at low-water there is only a fall of a little over three feet. During the same time Seven League lake has a total fall of two and a-half feet in times of high-water, and at low-water there is only a fall of half a foot from the north to the south end. These seeming anomalies are thus explained by Mr. Thomas Guerin:*—"The Long Sault * * * is divided at its head by an island into two channels, the level of the bottom of the eastern channel being about seven feet below that of the bottom of the western channel which becomes dry at low-water. * * * The outlet from Seven League lake is at the Mountain rapid, and the capacity of the channel here is less than the united capacities of the two channels, which constitute the outlet from Lake Timiskaming. Hence the latter channels during high-water pour a greater quantity into Seven League lake than the outlet of the latter is able to discharge, thus causing Seven League lake to rise, while Lake Timiskaming falls so that the difference of level must be least at high-water. Again when the level of Lake Timiskaming falls so low as to render the western channel dry then the outlet from Lake Timiskaming will be confined to the eastern channel, which is nearly of the same dimensions as the outlet of Seven League lake, but as the area of the latter lake is many times less than that of Lake Timiskaming its level must fall faster, and the difference of level must be greater at low-water than at any other times."

The rate of discharge from Seven League lake was measured by Mr. Guerin at the current immediately above the Mountain rapid, on the 21st of August, 1884, and found to be 16,383 cubic feet per second. From a comparison of the levels then prevailing it was calculated that the rate of discharge during times of high-water would be 25,100 cubic feet per second, and during low water 14,800 cubic feet per second.

The trend of the Ottawa valley, from its confluence with the Mattawa to the foot of Lake Timiskaming, is nearly northwest, making a considerable angle with the direction of the foliation of the gneissic rocks along its banks. At the mouth of the Mattawa a sharp elbow is formed, the valley below that river turning nearly east, in close correspondence with the foliation of the gneisses, and coinciding in direction with the depression occupied by the Mattawa river. The sharpness of this elbow is further accentuated by the fact that, for several miles above this point, the course of the Ottawa river is nearl north-and-south.

The river from Mattawa to the foot of Lake Timiskaming is interrupted at intervals by heavy rapids, three of which occur on the fir fourteen miles, while the Long Sault, seventeen miles farther up, is six miles in length.

The first rapid, four miles above the Mattawa, is now known as L Cave. It is about half a mile in length and is divided into two leap the lower of which was formerly known as La Cave, while the upper portion was called the Demicharge Chaudron, or Chaudière. The combined fall is nearly ten feet, divided into two nearly equal part The river between the Mattawa and La Cave rapids averages abo

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*Annual Report, Minister of Public Works, 1884-85, pp. 107-108.

a quarter of a mile in width, although in one or two places where bays are present this width is nearly doubled. Antoine creek is the main tributary in this interval, coming in from the west and draining in its course the larger portions of the townships of Mattawa and Olrig, its source being in some small lakes situated in the southwestern part of the township of French.

From La Cave to the next rapid, known as Les Erables, is a little over three and a half miles, while the width averages about a third of a mile, and occasionally somewhat less. Les Erables rapids are a little over half a mile in length, with a descent of nearly thirteen feet. Latour island, at the foot of this rapid, and almost in the middle of the current, shows a large number of pot-holes worn out in the rock. All stages in the process may be seen from the incipient canals, where the eddies have commenced to wear down along the jointing planes that cut the rock to holes ten feet in diameter. In a few instances several holes are seen to have been so greatly hollowed out that they ultimately joined at or below the surface.

Cotton creek enters from the east a short distance below the foot of Les Erables rapids, forming a beautiful cascade as the water tumbles over the rough ridges of gneiss which impedes its progress. This stream drains a number of lakes, of which Lake Memewin, situated about four miles to the east of the river, is the largest, being four miles long, and very irregular in outline. Scarcely three miles and a half intervenes between Les Erables and The Mountain, where the whole volume of the river flows through a narrow channel obstructed by rocky reefs and islets. About a mile above Les Erables rapids another stream enters from the east, with a steep descent into the valley of the Ottawa. This stream, now known as Snake creek, drains a number of small lakes, the largest of which is Snake lake, while the headwaters are in a small lake, from which only a short portage is necessary to reach Obashing lake. It thus formed a portion of the old winter route, which left the Ottawa river at the mouth of this creek and reached Lake Timiskaming a short distance below the Opimika narrows. About a mile below the Mountain rapid one of the highest hills was ascended and found by aneroid barometer to be 520 feet above the surface of the water. The average height of the hills on either side would, therefore, be little less than 500 feet.

Seven League lake is a stretch of navigable water nearly seventeen miles in length, extending from the head of the Mountain to the foot of the Long Sault rapids. The banks in most places are steep and rocky, and one or two places perhaps deserve special mention. Devils Garden bluff, on the east side, presents a sheer precipice of gneissic rocks, and receives its name from the fact that a patch of wild onion grows near its summit. Above this, on the west side and only a short distance below the foot of the Long Sault rapids, there is a sharply accented hill thickly overgrown with small pine trees, which, from its marked resemblance to the characteristic headgear of the Canadian "habitant," has always received the designation of "La Tuque." This is a rather important and well known land-mark.

Three important tributaries enter Seven League lake. The first of these, known as East creek, has its source near the eastern limit of the southern map-sheet, and is thus not more than seven miles long, reaching about six and a half miles below the foot of the Long Sault. The next stream, however, which enters on the west side about half a mile farther north, is much larger, and named Jocko river, after a half-breed of that name. Formerly the stream was known as the Siconaguisipi or Blackstone river, a name appearing in Sir William Logan's report on the region, although on his manuscript map it is designated as the Porcupine river. The main branch of this stream heads in a lake about two and a half miles long, bearing the same name, and situated about the centre of the township of Osborne, a little over twenty miles in a straight line from the outlet. Its northern branches drain the northern parts of Osborne and Garrow townships, and also a considerable area of unsurveyed land between these townships and Nevin's base-line. The southern branches drain almost the whole of the townships of Stewart and Lockhart, this area being but slightly less than seventy square miles. The river has carried down a quantity of loose material which fills up a large area of the lake in the vicinity of its mouth. It flows through a steep, narrow valley, and in debouching on the lake the channel makes a sharp bend northward through the gravel sand, thus forming what has often been called a "square fork." This delta is 200 yards wide and about a quarter of a mile long, and may owe its origin partly to glacial accumulation and deposition. If it occurs as a result of stream action it evidences a river of much greater volume than that which now occupies this valley.

The Obashing is the third stream of importance entering Seven League lake in a bay on the east side close to the foot of the Long Sault rapids. The lower portion of this stream meanders through a sandy flat which extends inland for some distance. The upper portion of the stream, however, is exceedingly rough and rapid, showing a total fall of about 300 feet in a distance of scarcely three miles. It affords an outlet to a large number of lakes in the region to the south of Kipawa lake, the largest of which is Obashing lake. The name is of Chippewa origin, and refers to the narrows which divide the lake into two very nearly equal portions. It covers an area of about eleven square miles, and measures ten miles from east to west, with an average width of from one to three miles. Two large tributaries enter the eastern end of the lake, the most northerly being known as the Otter river.

The Long Sault rapids separate Seven League lake from Lake Timiskaming, and are caused by a great accumulation of very coarse gravel and boulders, many of the boulders at the head of the rapids are exceedingly large, measuring from twelve to fifteen feet in diameter. The rapids are usually very narrow and crooked, and a little over six miles in length. Very little rock *in situ* can now be seen, although it is evident from the topography that the detritus was deposited in a pre-existing shallow narrows. On the east, or Quebec side, the drift material forms a comparatively level space, varying from a quarter to half a mile in width, along which the railway-line is constructed. With skilful canoemen it is customary to run the Long Sault rapids in the larger voyaging canoes, but five portages and tracking lines are necessary when an ascent is made. The three lower portages are on the east side of the stream, and the two upper ones on the opposite bank.

Two streams fall into the Ottawa at the Long Sault, one from either side. McDougall creek, which flows in from the west at the Crooked rapid, takes its rise in some small lakes about ten miles to the northwest, and Gordon creek enters about a mile below the head of the Long Sault. Logs are brought from Kipawa lake by an artificial channel into Gordon creek, down which they are run. The total fall of Gordon creek from Kipawa lake is about 300 feet, nearly 250 feet of which is below Pike lake in a little over a mile.

Lake Timiskaming is usually regarded as commencing at the head of the Long Sault. The name means literally "at the place of the deep dry water," doubtless referring to the existence of the extensive clay flats in the northeastern portions of the lake which are sometimes dry. The lake is sixty-one miles long in a bearing N. 26° W., with an area of about 125 square miles. From the head of the Long Sault to the Narrows the lake is about a quarter of a mile wide, but at the foot of the Narrows it increases in width to about a mile, on account of Thompson bay, situated on the east side. Both shores are steep and high, and in several places there are almost perpendicular cliffs over 200 feet in height. On the Ontario side especially the hills are covered with a good growth of pine almost to the water's edge, which effectually conceals the rock beneath. A portion of the Quebec side, between the Narrows and Schooner island, has, however, been almost denuded by fire of its original forest growth, and exposes the rough and broken ridges of gneiss. Schooner or Ship island evidently represents the apex of a bouldery shoal, as no evidence of a rock *in situ* could be found. Presquile, about a mile above the head of the Long Sault, has been designated as an island, and although comparatively deep bays approach close to one another on the north and south sides a small neck of land unites the so-called island with the eastern shore. It evidently represents an older accumulation of morainic material which in so many places blocks the channel of the river.

The Opimika narrows are about two miles in length, and very crooked and contracted towards the northern end. High rocky hills form the immediate coast-line on the west side, but on the east side the shore is composed of sand, gravel and boulders, forming a flat over a quarter of a mile wide to the base of the rocky hills. The greatest contraction is towards the north end, where the shore-lines are only a little over a hundred yards apart. Two creeks enter the Ottawa at the Opimika narrows. The largest one, now known as White creek, drains two or three small lakes between this point and Kipawa lake, the largest of which, White lake, is over half a mile in width, and two miles in length; the eastern end approaching within about three miles of Kipawa lake. The other creek is known as Green creek, and enters from the west side, draining some small lakes in that direction.

Above the Opimika narrows the lake widens almost immediately and from this point as far north as the mouth of the Montreal river it has an average width of from three-quarters of a mile to a mile. The shores are very bold, often exhibiting nearly vertical precipices of rock for many miles at a stretch. Occasionally small portions of the shore-line are composed of sand and gravel, but high trees rise almost immediately behind. McMartin and Ouellette points are small, low, projections running out a small distance into the lake and are composed wholly of sand and gravel except in the case of McMartin point, where some of the solid rock projects through the loose material. In the vicinity of McMartin point a considerable amount of stiff grey clay was noticed, and a bank of this contains a large number of very irregularly shaped calcareous nodules, but fossil remains were found in them. The hills on either side of the lake are from 300 to 500 feet above the surface of the water, and th highest, known as the King of the Beavers, rises to a height of a 600 feet. These hills evidently form the edges of an undulating plateau which extends inland on both sides, and in which the valley of the lake has been excavated. Buffalo rock is another well kn topographical feature, consisting of a rocky precipice on the w shore of the lake, and so named from a mass of vegetation upon it, which has a fancied resemblance in outline to a buffalo.

Six tributaries may be mentioned which flow into the Ottawa between the Opimika narrows and the mouth of the Matabitchouan river. The first of these is Opimika creek that enters a beautiful sandy bay on the west side, known as McLaren bay, about half a mile north of the Narrows. The water of Opimika creek is extremely clear and cold, abounding in speckled trout. Although its actual source is in a small lake about nine miles to the southwest of the Narrows it derives most of its water from two lakes some four miles to the southwest, which are supplied by a series of large springs. One of these lakes is called Emerald lake, and is remarkable for containing a deposit of shell marl which is described in that portion of the report treating of economic geology. The small pond at the head of the stream is 580 feet, by barometer, above Lake Timiskaming.

About three miles farther on Ottertail creek reaches the lake from the west. This stream forms a portion of a route to the west. The main or southern branch takes its rise in a small lake some twenty miles to the southwest in the township of Hammell, within a mile of Spruce lake, at the head of the Tomiko river. About a mile above McMartin point a small stream enters from the east, draining White Beaver lake, and three miles south of the mouth of the Kipawa river another small stream enters which is notable as being the old Indian portage-route to Lake Kipawa.

The next stream is the Kipawa river, forming the outlet to a great number of large lakes, many of which are outside the boundaries of the present map. The largest of these lakes is of course Lake Kipawa, which is nearly thirty-two miles in a straight line from north to south, and, with its intricate shore line of bays covers an area of 120 square miles. The Kipawa river is nearly nine miles in length, with a total fall of about 300 feet, and has a number of powerful rapids and chutes in its circuitous course. At the mouth is a very fine chute. The Matabitchouan and Montreal rivers, which enter the lake at the same place, are elsewhere separately described.

North of the Montreal river Timiskaming lake gradually widens. The western coast-line continues to be rather even and unbroken and is also as a rule steep and rocky. At the Crowsnest rock, opposite Bryson island, as well as at Manitou rock opposite Mann island, there are sheer precipices that extend for several miles, varying from 150 to 200 feet in height. The east side of the lake shows more irregularity in outline, and large areas of level land exist, from which, however, bold hills rise in places. There is much more cultivable land in the aggregate than the often rocky character of the lake-shore would indicate.

Below the Old Fort narrows there are only a few small and insignificant islands. Roche McLean, so named after an old North-west Company fur-trader, as well as the island north of Pointe à la Barbe, are both connected at low-water with the western mainland by narrow bars of sand and gravel. Moose rock is a huge boulder of breccia-conglomerate about thirty feet in diameter, situated some four miles south of the Narrows. North of the Narrows there are several islands, of which the most important are Bryson island, Mann island and Chief island, the latter being a well known topographical feature. It is high and rocky, and at low-water is connected at its eastern end with the mainland by a bar composed of boulders and clay; although, during the early part of the season, there is often sufficient water to permit of the passage of the steamer. To the northwest of the island a similar bar exists, which, at low-water, prevents the steamer proceeding any farther, although the channel inside is quite deep. The presence of this boulder barrier is probably due to its deposition, in part at least, in a crack or rift in the glacier that evidently occupied the valley of the Blanche river towards the close of the glacial period.

The northern part of the lake, from the Old Fort narrows to the mouth of the River des Quinze, has more the appearance of a lake than any portion farther south. The deepest water is to the west of Mann and Bryson islands, and is the route usually followed by the steamer. At ordinary summer level it is impossible for a steamer drawing six feet of water to pass between Bryson island and the Quebec mainland, and the lake for a long distance outward, opposite Wright's mine, is comparatively shallow. Kelly, or, as it is now called, Priests bay, where the chief settlement of the district is situated, presents a long stretch of gently sloping clay flats, extending out from the shore opposite the village of Baie des Pères, and, usually, towards the end of August and in the month of September there is not more than five feet of water at the end of the long wharf, so that for a considerable portion of the season the steamers are compelled to anchor fully half a mile from shore, and lighter their passengers and cargo.

The north shore of the lake is divided into two deep bays by the high rocky promontory terminating at Dawson point. The high limestone table-land of which this forms a part is over two miles in width, presenting a very steep escarpment of light cream-coloured limestone facing eastward and running in a N. N. W. direction beyond the borders of the map. Wabi bay is a little over two miles wide and three miles in depth, receiving at its head the waters of Wabi creek, at the mouth of which is situated the promising settlement of Liskeard. Wabi creek is a stream of considerable importance, rising beyond the north boundary of the map and draining a large area of arable land to the northwest, most of which has recently been laid out in townships and subdivided into lots. The borders of Wabi bay are in general low, with a marshy fringe along its northwest shore, while the water is extremely shallow and the shore difficult of approach except by means of the very crooked and narrow channel which the stream has hollowed out on the hard clay bottom. The northeastern part of the lake is divided into two bays known as Sutton and Paulson bays, separated from one another by the low marshy delta marking the mouth of the Blanche and Quinze rivers. The greater portion of Sutton bay is a low sandy flat almost completely dry at low-water.

When the lake is at its ordinary summer level there is scarcely a foot of water covering the extensive clay flats in the vicinity of Chief island except in the various channels which the steamers entering in this vicinity have hollowed out. During low-water, occuring in September of 1887 and 1894, the greater part of these clay flats was exposed, the water being confined to these comparatively narrow channels. Three large tributaries enter the lake in this neighbourhood and a fourth, known as Apika creek, about eight miles in length, drains the western portion of the township of Guigues. The largest of these streams is the one which really constitutes the upward extension of the Ottawa river, now known as the Rivière des Quinze or Quinze river. The other two, in the order of their importance, are the Blanche river and the Otter river, often also called Ottertail river, especially on the maps issued by the Crown Lands Department of Quebec. Only about five miles of the lower portion of the Blanche river is shown on the Lake Timiskaming map-sheet. The source of the stream is in Round lake, situated about forty-four miles from its mouth in a northwesterly direction, but owing to curves in the river the distance is nearly sixty miles. The waters of the Blanche river enter the lake through four somewhat intricate channels, between three low marshy islands formed by the large amount of loose material deposited annually by this stream. Two of these islands, known as Wright and Rousselet islands, are of considerable size. The deepest channel is called the Chenal du Diable, and is navigable for small steamers at high-water. The next channel farther south is known as the Crow channel and is fairly deep, but the other two channels, which are more in line with the upward course of the stream, are almost completely choked with sand and other detritus, so that they can scarcely be navigated by canoes during ordinary stages of the water.

About five miles from its mouth the depth of the river varies from sixteen to twenty-four feet, and the width from 320 to 400 feet, and at a distance of twenty miles from its mouth it is 220 feet wide and eight feet deep. Here a small rapid occurs, with a fall of about two feet, but above this is a quiet stretch of water for nearly six miles farther. It will thus be seen that, at low-water, the river is navigable for a distance of twenty-five miles for steamers drawing under three feet, while at its highest stage this distance is increased to over thirty miles. The Blanche river has cut its channel through a thick deposit of drift material, composed chiefly of clay, and the sections thus furnished are probably the best in the whole district. The valley consists of a series of four or five rather extensive flats or terraces, rising, one above the other, to the northwest of the lake, and evidently forming the continuation northward of the depression occupied by Lake Timiskaming. Near its mouth the banks of the river are quite low and subject to inundation, with large areas of tamarack and spruce swamp. As the stream is ascended, however, the banks gradually increase in height, and thirty miles inland they are more than one hundred feet above the level of the stream. Twenty-five miles from the lake the banks are eighty or ninety feet high, and furnish a good section, which is as follows in descending order:—First, two or three inches of vegetable mould, then about a foot of reddish brown sand merging into a grey clay, and below this, again, a bluish clay, which extends to the base of the cliff, forming the bed of the stream. Bluish clay is exposed, according to McOuat,* in the bed of the river all the way to Round lake, but about half-way up is overlain by a rather coarse, brown sand, which, in its turn, farther up, is again overlaid by clay. Six or eight miles below Round lake, where the cliffs are upwards of a hundred feet high, the middle portion consists of sand, while at the base and summit nothing is seen but clay.

The Otter river drains by far the larger portion of the area to the southeast of this part of Lake Timiskaming. The main stream rises about six miles southeast of Lac aux Feves, where it occupies the same depression as Chemagan and Hay bays of Lake Kipawa. Its channel is very tortuous, and in its lower portion has an average width of about 100 feet, with a depth of ten feet, while its rate of discharge was measured by Mr. Guerin as 229 cubic feet per second, or less than one half that of the Blanche, and its velocity twenty-six feet per second. It is navigable by canoes without interruption for a distance of about ten miles from the mouth, and is frequently used by the settlers in going to and returning from North Timiskaming.

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*Report of Progress, Geol. Surv. Can., 1872-73, p. 134.

About six miles from the mouth the Cameron branch enters, and, with a general course of nearly east-and-west, has its headwaters in a small lake only a mile west of Lac des Quinze. This tributary also serves to empty two considerable lakes, known as Long and Sassaganaga, the former about three miles in length, but with an average breadth of scarcely a quarter of a mile, while the latter is two and a half miles long, with a somewhat uneven shore-line and containing several islands, and has an approximate breadth of a little over half a mile. The south branch, or Duford river, drains the larger portion of the township of Duhamel, rising in a small marshy lake about the centre of the township. This stream is rather crooked, even in its larger bends, while it meanders in a very tortuous manner through clay flats.

Geological Description.

The village of Mattawa is built upon a bouldery terrace of morainic origin, which, subsequent to its deposition, has been modified to a considerable extent by the scouring action of water. This boulder-covered field or plateau has a somewhat uneven contour, but in general it may be said to rise from thirty to seventy feet above the river. It is only one of many similar occurrences to be found in the neighbourhood of the Ottawa river, all of which seem to owe their accumulation primarily to deposition from a melting detritus-laden glacier. This bouldery terrace begins nearly a mile up the Mattawa river and extends a little over half a mile down the southern bank of the Ottawa. In the angles formed by the junction of the two streams it has its maximum development, producing a bar consisting almost wholly of boulders and coarse gravel, which stretches nearly across the river, leaving a deep though narrow channel near the Quebec shore. The boulders about Mattawa vary in size from a few inches to as many feet in diameter, while many of them measure from ten to fifteen feet across. By far the larger number of these erratics consist of very evenly foliated gneiss, and have not been carried far from their original positions. Some are red and grey granite, while a few are of greenish gabbro or diabase. Recent cuttings show that the bouldery layer overlies silts and other fine deposits. A well defined old river-channel occurs, running through the rear portion of the village between the main street and the railway station, which has evidently been followed by the Mattawa or its antecedent stream. It leaves the Mattawa about a mile above the mouth, and reaches the Ottawa at the foot of the rapid, nearly three-quarters of a mile below.

On the north side of the river a steeply scarped though somewhat narrow terrace rises to a height of nearly eighty feet above the level of the river. Near the junction with the Ottawa this terrace is composed of well-rounded fragments or small boulders with coarse gravel and sand, this material being in a much finer state of division than that on the south side.

Opposite the village of Mattawa, on the north side of the Ottawa, is "Mattawa mountain," about 600 feet high. It is composed of a greyish granite-gneiss, consisting of the usual alternation of lighter and darker bands, causing a distinctly marked foliation. The strike of this foliation corresponds closely with the trend of the hill, being nearly east-and-west, while the dip is about 20° to the south. In places it contains an abundance of rather small garnets, especially numerous in the darker or more basic portions of the rock.

At many points this gneiss is cut by dikes of pegmatite, varying irregularly in breadth from a few inches to several feet. These pegmatites are composed usually of a flesh-coloured orthoclase or microcline and quartz. Occasionally a white plagioclase, probably oligoclase, was noticed in the same dike with the orthoclase, while the ferro-magnesian constituent is sparingly represented, if at all, and is usually biotite. The quartz is as a rule segregated in the centre of each dike, leaving an almost pure feldspathic margin of varying thickness. Many of these dikes cut the foliation at considerable angles, running from S. 40° W. to S. 55° W., while others, especially the smaller ones, conform very closely to the foliation.

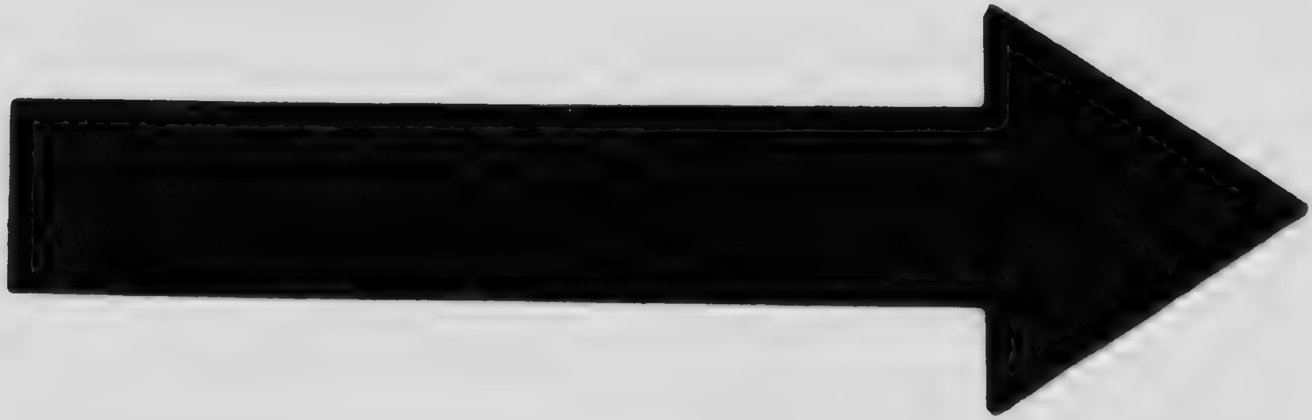
It is quite apparent, from the many conflicting local dips and strikes observed in the area to the south of the Ottawa river, and extending for a few miles east of Mattawa, that the gneissic rocks rise into a series of small domes, each presenting quaquaversal dips while, on the other hand, the complete examination of this small area has also shown that the grander structural features of these rocks exhibit a rather constant dip at low angles, varying in direction from south to S. 10° W. These gneissic rocks are well foliated and of a dark-grey colour where the bisilicate material is present in relatively greater quantity, while a prevailing reddish tinge is usual when feldspar present increases. Some bands exhibit the "augen" structure in great perfection.

About a mile east of Mattawa the main line of the Canadian Pacific railway has cut through the axis of one of the most perfect of these dome-shaped bulges. The gneiss occurs in alternating light and dark coloured bands which exhibit very sharp lines of demarcation one from the other. The main axis of this dome runs in a direction S. 80° E., the dips on the north side of the railway track thus turning from N. 80° W. all around to S. 80° E.; while on the south side of the track dips exactly the opposite of these may be noticed

The gneisses contain a large percentage of pyrite, and all the joints and fissures are plentifully coated with brown hydrous oxide of iron due to the decomposition of this mineral. The rocks crumble and fall to pieces when exposed to the action of the atmosphere for any length of time, giving rise to a coarse brownish sand that constitutes much of the soil of the region surrounding Mattawa.

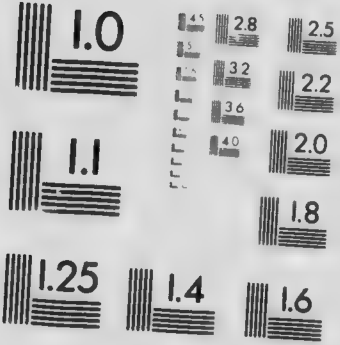
About a mile and a quarter east of Mattawa the gneiss has a dark reddish-grey colour, the reddish tinge being due to the presence of feldspar, which is in reality much more abundant in certain bands than in others. On the surface the gneiss presents a smooth hard crust that is evidently merely the result of weathering, while beneath this thin coating the rock has undergone somewhat advanced decomposition, being yellowish in colour and comparatively soft and friable. This outer induration is very frequently characteristic of the exposed surfaces of both gneisses and the Huronian sandstone and greywackés, and, as has been shown by Irving and Van Hise, is caused by the secondary enlargement of the quartz and feldspar individuals, the interstitial material constituting interlocking areas which are optically continuous with the original grains.

To the west of Mattawa the railway follows up the valley of a creek that empties into two small lakes the larger of which is known as Earls lake. The shores of both these lakes are low and grassy, with only one rock exposure at the western end of Earls lake. Between Mattawa and Calvin stations the rock is usually well foliated granite-gneiss, although in one or two places it is very massive, and the foliation is either absent or quite indistinct. Some of the bands differ in colour from dark-grey to almost black where the biotite is exceptionally abundant; others are light-grey, while still others are of shades of flesh-red or pink where the feldspar is plentiful and is of that colour. The component bands are frequently so irregular in their development and in places so contorted, while the region as a whole has undergone such uneven truncation, that it is often exceedingly difficult to pronounce with any degree of certainty as to the direction of either the dip or the strike. In general, though, these rocks gradually bend round from S. 45° W. a little west of Mattawa, to S. 80° W. in the vicinity of Calvin, with a common dip at a high angle to the south. One of the pegmatite dikes noticed about two miles west of Mattawa is composed of a very large quantity of flesh-red feldspar in coarse cleavable masses, some quartz and a considerable amount of dark-coloured mica in large crystals and plates, doubtless a partially bleached biotite. All of the rocks are well rounded and glaciated, and although the striae are not very plainly marked



MICROCOPY RESOLUTION TEST CHART

(ANSI and ISO TEST CHART No. 2)



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some indistinct ones have a southwest direction, and are thus referable to the period of general glaciation.

In the angle formed by the junction of the Mattawa and Ottawa rivers, and to the north and east of these streams, the foliation of the gneiss shows a curious fan-like arrangement, the convergent lines pointing towards the Ottawa, where the gneiss shows a rapid change in strike from nearly east and west at the southern end of the rock exposure to N. 25° W. at the northern end. This structure is, however, only a local feature, and is confined to a small area. To the west this fan-like formation broadens, the bands near the southern end curving round rather sharply to the southwest to meet those exposed on the shores of Boom lake and in the vicinity of the Plein Chant rapids on the Mattawa, where the gneiss strikes from S. 30° W. to S. 60° W. with a southeasterly dip < 40° to 45°. To the north, as the Ottawa river is ascended, on the west shore the strike of the gneiss changes first to the west and then to N. 75° W., which latter seems to be the general direction of the foliation in the vicinity of the Cave rapids. At the bluff on the east shore the rock is composed of alternating bands of light and dark-grey micaceous gneiss, evidently of the ordinary granitite variety, and shows a strike of N. 55° E. and a dip to the south < 10° to 15°. About this again the foliation exhibits a change in direction, and about three-quarters of a mile below the Cave rapids a strike of S. 75° E. was noted, with a dip southward < 20°. A little above the rapids the evenly foliated grey gneiss trends in a northeasterly direction, dipping to the southeast < 30°. Between the Cave and Les Erables rapids the granitite-gneiss, which in the more basic bands seems to contain some hornblende in addition to the biotite, varies in strike from S. 70° W. to N. 70° W., with a southerly inclination.

Les Erables rapids are caused by the outcrop of ledges and islets of gneiss, which obstruct an already much contracted channel. The strike is N. 70° W., while the dip is northwards at an angle usually considerably less than 10°. A little above these rapids the foliation has an almost east-and-west direction, while near the mouth of Snake creek the strike is N. 80° E., and the dip S. < 70°. From the head of Les Erables rapids to about half a mile beyond the mouth of Snake creek the exposures, which were very closely examined, show a gneiss composed of alternating bands of light and dark-grey colour. The bisilicate present, which from its preponderance gives the dark colour to certain bands, is biotite, and the rock is thus a granitite-gneiss composed essentially of feldspar (chiefly orthoclase), quartz and biotite. Besides these constituents there are others which in places are so abundant as to characterize the rock. The principal and most interesting of these is cyanite, although individuals of an almandine-garnet are usually numerous, especially in the more basic portions; while graphite was noticed finely, though rather thickly, distributed through the rock. Cyanite of a prevailing blue colour is frequently so plentiful as to characterize large exposures of this gneiss. It occurs in rectangular or flattened prisms, which are very long and blade-like in their habit, presenting round, jagged, or irregular terminations.

About a mile below The Mountain rapid the high hills on the east shore are formed of alternating bands of light and dark-grey garnetiferous granitite-gneiss, striking S. 55° W., and dipping southeasterly < 45° to 60°.

At the foot of the Mountain rapid the gneiss is more massive in structure, although still preserving a distinct foliation that runs nearly east and west, while the dip is to the south < 35° to 40°. In places it is filled with small crystalline or irregular fragments of garnet, while the rock in general has a distinct reddish colour. The Mountain rapid runs for the most part in a strike of the rock, which is a dark-grey, well foliated gneiss. The ridges and islets are composed of this gneiss, presenting a strike varying from S. 50° E. to S. 55° E., with a dip to the northeast < 20° to 30°.

About a mile above the Mountain rapid, on the west side, the dark-grey, micaceous or granitite-gneiss strikes S. 70° W., with a dip to the south. About one and a half miles above this point a grey gneiss was noted with a decided foliation, exhibiting a series of beautiful curvings and twistings, while the general strike is N. 60° E., with a dip to the southeast < 65° to 70°. About four miles above the Mountain rapid a massive, fine-grained, red gneiss was noticed, associated with some more evenly foliated, grey gneiss; the whole dipping south < 40° to 80°. In the vicinity of the narrows of Seven League lake, and for some distance beyond, the gneiss is in many places much contorted, and usually of a dark-grey colour, owing to the prevalence of the more basic bands. In many places the rock runs in long curves, presenting a gentle undulating dip, which often approaches horizontality, while at other points not far removed the bands are almost on edge. Beyond the narrows on Seven League lake the gneiss, which has a grey colour and is well foliated, strikes about S. 65° E., with a southerly dip at a low angle, generally from 20° to 30°. Opposite La Tuque, on the east shore and below the mouth of Obashing creek, the lighter coloured bands, which are reddish, alternate with those of a dark-grey. These constitute a granitite-gneiss, which generally dips S. 25° W., < 10° to 20°, although in some places it seems perfectly horizontal, and in others it is much contorted.

At the foot of the Long Sault the reddish granitite-gneiss dips S. 20° W., < 25°. In many places along the shores of the northern part of Seven League lake the darker and more basic bands of gneiss contain epidote in very considerable quantities, indeed sometimes so abundant is this mineral as to give a yellowish tint to the band in which it is contained.

The country between the Long Sault rapids and Lake Kipawa is composed of high, rocky ridges of flesh-red and dark-grey gneiss, the former prevailing, while the alternation of both produces a marked foliation in the whole mass. The darker bands are made up mostly of the coloured constituents, while the lighter ones show a relatively greater quantity of quartz and feldspar. The general strike varies from S. 50° E. to S 60° E., while the dip is under 30°. A thin section of what was regarded as a typical specimen of this gneiss showed it to be a quartz-mica-diorite-gneiss, although it is probable that other and more acidic portions would show the ordinary granitite-gneiss, as well as the hornblende-granitite-gneiss, to be present. The rock, as examined under the microscope, showed the chief mineral constituents to be plagioclase, quartz, some unstriated feldspar (probably orthoclase) and a little microline, hornblende, biotite and epidote, with smaller quantities of titanite, pyrite, zircon, allanite, apatite and hematite.

On the Big Obashing lake the gneiss is usually well foliated, often of a light-grey colour, although some portions present reddish-coloured bands where the feldspar contains much iron oxide, and the general strike in the vicinity of the narrows varies from S. 66° E. to S. 75° E. with a dip to the south < 15° to 30°. At the east end of the little island, in the bay out of which the road goes south to the small lake at the headwaters of Snake creek, the gneiss is composed of alternating reddish and dark-grey bands, in places somewhat contorted, and shows a general strike of S. 85° E. with a dip to the south < 70° to 80°. Near the east end of Obashing lake the dark-grey well foliated gneiss strikes S. 84° E., and is either quite vertical or dips at a very high angle to the south.

Near the outlet of Little Obashing lake the gneiss, which is distinctly foliated and has a reddish colour, strikes east and west, dipping south at an angle of about 35°. The smaller lakes to the southwest of Little Obashing lake generally present high shores which are well wooded and green to the water's edge, so that there are only limited opportunities afforded for ascertaining the trend of th bordering gneiss. On a small island in Thompson (or McConnell lake), however, grey gneiss was noticed dipping S. 20° W. at a low angle.

Near the head of the Long Sault, on the west shore of the Ottawa, the gneiss is composed of alternating light and dark bands. Many of the lighter bands have a flesh-red colour where the feldspar is abundant, while others are greyish or nearly white. The dip is S. 30° W. < 20°.

There are comparatively few exposures of rock between the head of the Long Sault and the Opimika narrows, and the strike at some of these is hard to ascertain with any degree of certainty. The general strike seems, however, to be S. 55° E., which is apparently maintained as far as Schooner or Ship island. On the east shore, opposite this island, the gneiss, which is exceedingly well foliated in alternating bands of light-grey, flesh-red and dark-grey colours, dips S. 10° W., < 30°.

To the south of the Opimika narrows, on the west side, and nearly opposite Lumsden depot (Opimicong P. O.) is a grey, rather fine-grained, evenly foliated micaceous rock, showing lenticular areas of quartz and feldspar which are comparatively free from coloured constituents. The microscope shows the rock to be a hornblende-granitite-gneiss composed chiefly of quartz, orthoclase, plagioclase, microcline, biotite and hornblende, with smaller quantities of ilmenite associated with leucoxene, sphene, apatite, calcite, zircon and epidote. The dip of this gneiss is S.W. < 45°.

This exposure marks the southern end of a great curve in the gneissic rocks, the Opimika narrows conforming closely with the strike of the rocks in their bend. At the southern end the strike is northwest; about half-way through it has changed to S. 75° W.; at the north end of the Narrows the strike is N. 15° W., while still farther north on the same side it bends around to N. 30° W., and near the mouth of Ottertail creek the rock strikes N. 35° E.

The gneiss, in this interval, is of the usual grey micaceous variety occurring in alternating light and dark bands, while the dip is to the west or northwest at high angles, usually about 65°. A thin section, cut from a specimen obtained at the exposure immediately below the mouth of Opimika creek, showed the rock to be a granitite-gneiss, composed chiefly of quartz, orthoclase, plagioclase and microcline, with biotite, epidote and sphene as its principal coloured constituents.

In the region to the southwest of the Opimika narrows the country is well wooded, and the few rocky outcrops encountered have a general southwesterly strike. Near the small bridge on the old McLaren lumber road, crossing Opimika creek less than a mile from the lake-shore, gneissic rocks are very evenly and distinctly foliated, showing interlaminations of reddish light-grey and dark-grey material, the whole having a strike of nearly north and south and dipping west < 20°. Two miles southwest of the lake other small outcrops of a light-grey granitite-gneiss occur, dipping S. 50° W. < 35 Near the end of McLaren road the rock is concealed for the most part by sand, but here and there hummocks of gneiss occur. One of these, situated about three-quarters of a mile from the end of th road, is composed of grey well foliated gneiss dipping S. 80° W. < 20°.

To the northwest of the Opimika narrows are situated Long and White lakes, which empty into Lake Timiskaming a short distanc northwest of Lumsden depot. These lakes are noteworthy as afford ing an opportunity of tracing in some detail the general outline of a immense curve in the strike, that, starting at the south end of th Opimika narrows with a direction N. 40° W., circles around to S 65° E. at the Beauvais narrows on Lake Kipawa. On Long lak the gneiss is composed of successive bands of reddish-grey, grey an flesh-red colours, which vary in strike from N. 20° W. to N. 7° W. while the attitude of the layers changes from nearly horizontal in th southwestern part of the lake to an inclination to the west of 35 in the northeastern part. On White lake the rocks curve aroun gradually to N. 53° E., and on the north shore the gneiss has a strik of only a few degrees south of west. These rocks are light-red, reddish-grey, light-grey to dark-grey gneisses, the layers running in low broad undulations with a prevailing southerly dip at angles varyi from 5° to 10°.

On the north side of White lake there is a reddish contorted gne very plainly foliated, a ferromagnesian constituent being present i long slender dark-greenish bands, while in the wider and more fel spathic portions such coloured constituents are almost entirely absen

To the northeast of McMartin point, on the portage going to Whit Beaver lake, the gneiss is exceedingly well foliated, running in long generally straight and somewhat continuous bands of alternatin light and dark-grey colour, and varying in strike from N. 40° S. t N. 50° E., with a prevailing northwesterly dip at high angles gener ally about 75°. Exposures on the south shore of White Beaver lak exhibit a light reddish-grey gneiss in successive bands of lighter o darker colours, the whole showing a changeable strike from N. 60 E. to N. 68° E., while the folia are nearly if not quite vertical.

Between McMartin point and Latour's mills the east shore of L Timiskaming is very high and precipitous and for consider stretches presents perpendicular rocky cliffs. For two miles ab McMartin point the gneiss is comparatively massive and chiefl the red variety, although grey bands may be noticed marking the foliation. The rock has, in general, a dip N. 65° W. < 35° to 80°. The combined action of the weather and the waves of the lake have served in many places to remove an appreciable portion of the softer and more micaceous bands, leaving the red feldspathic parts standing out in rather prominent relief, smoothed and planed as a result of glacial action. The surface now exposed exhibits, in great perfection, even the smallest bendings and foldings which these rocks have undergone. In the last half mile of the distance already mentioned the gneissic rocks seem to strike approximately with the trend of the shore-line, exhibiting beautiful examples of contortion, while in other places the rock lies in a series of low undulating folds. Above this, for a little over four miles, and extending a short distance beyond Latour's mills, are almost continuous exposures of micaceous or granitite-gneiss, which is so evenly laminated that slabs could readily be obtained of almost any dimensions for flagstones. The strike is very regular, generally about N. 15° E., and the dip easterly < 50° to 80°. The alternating bands composing the gneiss are usually reddish, greyish and dark-grey in colour.

On the western shore, for a short distance both above and below McMartin point, the rocks are somewhat similar in character, the strike varying from S. 35° W. to S. 90° W., while the inclination, which is towards the northwest, changes from an angle of 65° to 35°.

About a mile above McMartin point, on the west shore, the gneiss is much contorted, and in one place presents a low, dome-shaped anticlinal arch, the banding of the gneiss dipping either to the northwest or southwest at low angles. Nearly two miles above McMartin point, or ten miles south of the mouth of the Kipawa, the gneiss is made up of alternate layers in which a relatively greater amount of feldspar and quartz or biotite and hornblende are respectively present. The darker bands have yielded somewhat extensively and unevenly to atmospheric decay, the feldspathic layers standing out in rib-like forms. The strike is chiefly to the southeast, while the bands have either an almost vertical attitude or dip at high angle, never less than 70°, in a southeasterly direction. Microscopical examination of a specimen representing the more basic portion of the rock shows it to be a quartz-mica-diorite-gneiss, composed essentially of plagioclase, orthoclase, quartz, hornblende, biotite and epidote, with sphene, apatite and zircon as accessory constituents.

Opposite Latour's mills, and for a short distance both north and south, the gneiss is well laminated, exhibiting precisely similar features to that on the opposite side of the lake. The feldspathic bands, which are usually flesh-red, are rather fine-grained and contain little quartz or mica, while the darker bands show a superabundance of biotite and other coloured constituents.

In several places, associated with this gneiss and evidently caught up in it, are irregular masses of a dark-green, almost uralitic diabase, with somewhat large and glistening scales of dark-brown mica. The surface of this rock weathers very unevenly, presenting a very rough and pitted character. This roughness is increased by a series of intricate, reticulating dikes of a fine-grained aplite or granite that stand out in strong relief. Under the microscope the rock is seen to be an altered diabase, the hornblende showing undoubted evidence of having been derived from pyroxene, while traces of a rude ophitic structure can still be detected. The other minerals present are biotite, plagioclase, garnet and iron ore.*

Between Latour's mills and the western end of the old Indian portage-route to Lake Kipawa the gneiss is not so regular as that farther south, and in some places runs parallel with the shore-line, while at others it forms considerable angles with this direction, making at least one great bend, which is shown on the accompanying map.

The rocks are either vertical or dip at high angles to the east and southeast. A little south of the Indian portage there are some dark-green, almost black, glistening bands of amphibolite, which occur for the most part interfoliated with the prevailing gneiss. These present many of the characteristics of parallel or interfoliated dikes, and some portions of them cut across the foliation, but their true relations were not studied in detail, so that it cannot be stated with certainty whether they are of later origin than the gneiss with which they are associated. The microscopic examination of two thin sections shows, that although it must be referred to as quartz-mica-diorite-gneiss, it differs in many particulars from the basic bands of the ordinary gneiss to which this name has also been applied. It has very evidently been derived from the shearing of a basic eruptive rock, resulting in its more or less complete re-crystallization, and several places were noticed throughout the region where a similar rock could be traced directly and continuously into the ordinary massive phase, which for some reason had escaped such complete deformation. One of the localities where this can perhaps be seen to the best advantage is on the shores of one of the smaller bays running to the northwest, and forming part of Leonard inlet, on the west coast of Shabosagi or Wicksteed lake. This amphibolite, or quartz-mica-diorite-gneiss, is composed of quartz, plagioclase, hornblende, with an iron ore (probably titaniferous) and epidote, garnet, apatite and zircon. Associated also with the gneiss near this

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*Section No. 58.

CUTTING IN GNEISSIC ROCKS, ONE MILE EAST OF MATTAWA, ON MAIN LINE OF C.P.R.

Showing the dome-like structure frequently noticed in highly differentiated gneisses.

point is some of the usual [illegible] already described as occurring on the west shore of the lake.

From the Indian portage northward to within about two miles of the mouth of the Montreal river the rocks present the usual alternation of reddish, grey, and almost black bands. The strike of the foliation is somewhat irregular or divergent, but the general directions are indicated on the accompanying map.

Martel point, as well as the shores of the small bay to the south, and some small rocky islets lying close to the eastern shore of the lake in this vicinity, are composed of a dark-green, almost black, diorite.

From Buffalo rock northwards along the west shore the strike of the gneiss does not show any wide variation, the general direction being from S. 45° W. to S 65° W. with a dip to the southeast [illegible] 40° to 80°. The general colours are shades of light and dark grey, with some reddish bands where the feldspar has been stained by iron. A specimen obtained from an exposure nearly opposite the mouth of the Kipawa shows a fine-grained, grey, evenly foliated, micaceous rock, slightly discoloured throughout by iron oxide. The microscope shows the rock to be a granitite-gneiss, consisting chiefly of orthoclase, quartz, biotite and epidote and bearing a close resemblance to the gneiss exposed near the north end of the Opimika narrows, although somewhat finer in texture.

The contact between these gneissic rocks, mapped as Laurentian, and the Huronian rocks, is exposed on the west shore of the lake about two and a quarter miles south of the mouth of the Montreal river. Immediately south of the small creek which enters the lake from the west four and a half miles south of the Montreal river the gneiss has a strike of S. 60° W. with a dip S. 30° E. < 85°, while in the bed of the creek itself the rock is apparently of a coarse dark micaceous variety, decomposed almost wholly to a chlorite-schist associated with some steatite or soapstone. For nearly a mile north of this the shore is composed of a flesh-red gneissic granite, striking from N. 60° W. to N. 70° W. and dipping to the southwest at high angles. The point about a mile to the south of the contact is occupied by a massive dark mica-diorite or uralitic diabase, intersected in various directions by dikes of red[illegible]issic material. Near the junction the Laurentian is represente[illegible] a light-reddish or reddish-grey gneissic granite, with somewhat indistinct foliation but no lamination. The rock is massive, rather coarse-grained, containing a comparatively small proportion of bisilicate material. Under the microscope it is seen to be a granitite-gneiss, the feldspar having undergone somewhat advanced saussuritization, while the biotite originally present has been wholly converted into chlorite.

The rock in contact with this gneissic granite on the west shore, representing the Huronian, is the typical and widespread breccia-conglomerate described by Sir William Logan as "slate conglomerate" or "chloritic slate conglomerate."

This rock contains numerous angular as well as rounded fragments among which those of a somewhat coarse flesh-red granite are the most abundantly represented. These granite pebbles are composed chiefly of flesh-red orthoclase, with a smaller quantity of greyish translucent quartz and relatively little biotite, which has evidently undergone very advanced alteration to chlorite. Occasional specimens of a dark-green rock, which seems to be an extremely fine grained and altered diabase, were noticed, while irregular and angular fragments of simple minerals, chiefly quartz and feldspar, are rather abundant. This coarse fragmental material is held in a dark green slaty matrix, in which chlorite and epidote are the most abundant constituents. Both the larger fragments and matrix have been subjected to intense and long continued pressure. The coarser fragments are squeezed out in a direction at right angles to the line of junction, while the softer and more yielding matrix curves around these inclusions.

The granite and conglomerate are very closely and firmly cemented together along their line of junction, and it would be quite easy, were it not for the broken and jointed character of both rocks, to secure pieces exhibiting portions of each in the same hand specimen. The line of contact in the immediate vicinity of the lake runs in a general direction of S. 75° W., but this line is not perfectly straight, as the granite has a somewhat sinuous edge which is followed very faithfully by similar irregularities in the schistose structure of the breccia-conglomerate. It is quite evident from an inspection of the coarser fragments that they have not been derived from the disintegration of the gneissic rocks with which these clastics come contact, for the minerals composing them are much coarser in their method of crystallization and of a deeper red colour, resembling closely in these particulars the granite exposed on both shores of the lake to the north of the Old Fort narrows. Besides, the rock in immediate contact with these Laurentian gneisses often contains far fewer fragments of such materials than exposures of similar rock farther removed from the line of junction.

The Huronian to the south of Montreal river, on the west shore of the lake, is, as a rule, represented by a fine-grained feldspathic sandstone, generally of a pale greenish-grey colour. Microscopic examination of a specimen obtained [illegible], a mile and three-quarters south of the mouth of the river shows this rock to be made up of ang sub-angular and occasionally of rounded fragments of orthoclase, quartz, plagioclase and microcline, cemented together by similar material in a finer state of division, with some chlorite, epidote and sericite often filling in the smaller interstices. In many places the rock is very hard and flint-like in character, breaking readily under the hammer with a splintery or conchoidal fracture. It occurs in somewhat thin beds, often shaly, dipping S. 83° W. < 20° while the set of cleavage planes which have been developed as a result of pressure dip S. 20° E. < 70°. At the point just north of the contact the rock is a greenish-grey compact slaty greywacké, which has evidently been subjected to great pressure and alteration, for a distinct foliation or schistose structure has been developed, the various bands of the rock being squeezed out into lens or pod-shaped areas, while pronounced curves in the direction of the schistosity may be observed, due to the equal resistance deformation offered different bands and portions of the rock. At the immediate line of contact the parallel structure of both Laurentian and Huronian conform with one another, these being produced as a result of mutual reaction, the resistance offered by the neighbouring clastic primarily determining the direction of the foliation in the granite, while the forces of upheaval in the gneiss have served to compress very materially the neighbouring clastic rocks. The Huronian strata which are here present form a curiously lengthened wedge-shaped strip between the Laurentian granite and the laccolithic or overflow mass of diabase which constitutes the summit of the "King of the Beaver."

On the east shore of the lake, from Martel point northward, the Laurentian is represented almost altogether by a pale flesh-red granite, showing little or no bisilicate material, the principal coloured constitutent being epidote, which is somewhat abundant. The contact between this rock and the breccia-conglomerate of the Huronian is, on the east side of the lake, about three miles north of the Montreal river. The actual contact is concealed, but outcrops of both rocks occur within a space of less than one hundred yards, and from these it would seem that the line intersects the shore at a point immediately south of a small creek which empties into the lake in this vicinity. Inland, the line is effectually hidden by overlying drift material, but its general direction seems to be very approximately N. 55° E.

The granite near the contact contains a large irregular mass of a coarse dark-green diorite. An area of finer crystalline chlorite-schist runs at right angles to the line of junction, and may represent either a small basic dike which has been subjected to pressure or an extremely altered fragment of the Huronian greywacké which has been caught up in the granite.

In the breccia-conglomerate the matrix is often present in very subordinate quantity. The most abundant fragments are of the usual biotite-granite type, while others of a pale greyish granite rock are seen in thin sections under the microscope to consist of phenocrysts of plagioclase or orthoclase embedded in a fine-grained quartz-feldspar groundmass. Besides these there are some fragments composed of a fine-grained altered diabase, and others of a greenish-grey slaty rock (resembling in a most marked manner the compact variety of the greywacké of the Huronian) and some grey quartz.

The material filling the interspaces is seen under the microscope to consist of a confused aggregate of scales and grains of chlorite and epidote, with abundantly disseminated particles of iron ore and fine granules of sphene and epidote. At first sight this conglomerate, occurring as it does in very massive beds with no pronounced parallelism in the arrangement of the larger fragments, seems devoid of any definite structural features, but a closer inspection shows the strike to be about N. 50° E. while the dip is to the southeast < 10°. As here exposed it forms a hill about four hundred feet in height, presenting a very sharp and abrupt northern face, while to the south it slopes more gradually down towards the line of demarcation between the two formations. To the north and west this rock is succeeded by a dark greenish-grey, compact, slaty rock which seems to underlie the breccia-conglomerate, although in other sections the conglomerate occurs at the very base of the Huronian. The exposures at this place, however, are not in immediate contact, so that the relations of the two could not be ascertained with certainty.

On the small island in Lavallee bay the rock is a fine-grained, greenish-grey greywacké, much squeezed and jointed, breaking with a conchoidal and somewhat splintery fracture. The small island near the east shore about a mile southeast of Roche McLean is also formed of a similar greenish-grey compact feldspathic sandstone rather massive in structure.

The western shore of Lake Timiskaming, from the Montreal river to Roche McLean, is occupied by the massive, bedded, breccia-conglomerate which dips in a westerly direction at an angle of 15°. This rock has already been described. A specimen obtained from an exposure about two miles north of the Montreal river, however, showed the matrix to be relatively more abundant than usual. The diabasic pebbles are also more plentiful than those of red granite, while fragments of simple minerals predominate greatly over those of composite rocks. The quartz and feldspar fragments are sharply angular, while the composite individuals are as a rule somewhat rounded.

In the conglomerate near Roche McLean the pebbles are more rounded and much more sparsely disseminated through the matrix. Pieces of an extremely altered diabase were noticed, and also some of a fine-grained greatly crushed quartz, filled with small scales of sericite and chlorite. The reddish pebbles are of the prevailing type of biotite-granite or granitite. Roche McLean itself is a large rounded and glaciated hummock of this breccia-conglomerate, separated from the west shore by a narrow interval at high water.

To the north of Roche McLean the western shore for a distance of a little over a quarter of a mile is occupied by a series of dark-grey slaty rocks, the only structural feature discernible being the planes of cleavage, which dip northward at a high angle. This comes in contact with, and is somewhat altered by, a small intrusion of diabase which is doubtless an extension of the large mass which comes out on the eastern shore at Quinn point. To the north of this diabase the massive breccia-conglomerate again outcrops, and is penetrated by a mass or dike of similar diabase, but with this slight interruption continues northward along the shore almost as far as Island point.

This point is so named because of the existence at high-water of a narrow and shallow channel separating it from the western shore. It is composed of a much squeezed, contorted and altered slaty greywacké, containing a considerable quantity of epidote. It is pierced throughout by small and intricate granitic intrusions which have evidently assisted materially in hardening and otherwise changing. To the north this rock is again succeeded by a conglomerate, containing the usual abundance of granitic fragments embedded in a dark-green diabasic or dioritic paste, resembling a diabase-tuff. About a quarter of a mile north of Island point this rock comes in contact with a fine-grained hornblende-granite that forms the shores of the bay to the south of Pointe à la Barbe, extending inland in a northwesterly direction and possibly connected with the mass of granite exposed on the western shore of the lake above the old Fort narrows, although it is very different in appearance from this.

In many places this granite shows dark patches, generally oval or rounded in outline, varying in diameter from a few inches to a foot or more. These patches are caused by the segregation of the coloured constituents and the more or less complete exclusion of the feldspar and quartz. They constitute what are familiarly known as the 'dark spots' (ausscheidungen) so commonly seen in granites, and evidently represent the first-formed nuclei in a slow-cooling magma.

Quinn point is the name usually applied to a series of rugged hills that form the shoreward extension of a pronounced range that extends with little interruption for some miles to the northeast. The rock composing these hills is a dark greenish-grey uralitic diabase, in which the ophitic structure is generally apparent to the eye. The rock varies in texture, the coarse phases assuming more of the holocrystalline or granitoid structure characteristic of gabbro. Jointed structure is very perfectly developed, one set of planes dipping westward < 80° while another series dips eastward < 12°. The rock is composed chiefly of plagioclase, which frequently contains much disseminated iron oxide, giving it a red hue, and hornblende, which has evidently resulted from the alteration of augite. A small quantity of some carbonate (probably dolomite) a little interstitial quartz and titanic iron ore were also noticed.

The Gull Rock islands are situated about half a mile north of Quinn point. There are two of them, presenting low rounded and well glaciated surfaces but little raised above the high-water level of the lake and almost destitute of vegetation. The rock composing them is the breccia-conglomerate containing very numerous and often well rounded pebbles and boulders, chiefly of red and reddish-grey granite, with some of a compact dark-green altered diabase and a few of a fine-grained greatly crushed quartzite. The matrix consists of the same sort of material in a finer state, with greenish chlorite filling in the smaller interspaces.

Moose rock is the name applied to a huge boulder of rounded outline perched upon a shoal. It is almost thirty feet in diameter and must have been detached from the cliffs of similar rock on the east shore, over a mile to the northward of its present site, and has been moved during the glacial period.

The northern end of Point à la Barbe, on the west shore, about two miles south of the Old Fort narrows, is formed by an island which, at high-water, is divided into two almost equal parts, connected by a slender rocky peninsula. The rock composing it resembles the finer-grained, hardened and altered matrix of the breccia-conglomerate. On the opposite shore a steep rocky point juts out into the lake forming a narrows. The breccia-conglomerate is here exposed for a considerable distance along the shore either way, reaching to within about a quarter of a mile of the mouth of the Little river. The shore-line at this point rises steeply into a hill nearly four hundred feet in height, forming the shoreward extension of conspicuous ridge that runs for several miles to the northeast, and mark the southern limit of the Little River valley. The rock has a strike of about N. 60° E., and a dip at low angle, less than 5°, to the northwest. The breccia-conglomerate here passes upward, by a gradual diminution of the larger fragments, into a compact, fine-grained arkose sandstone or greywacké that is exposed along the shore toward the mouth of the Little river. Under the microscope this rock is seen to be made up of partly rounded fragments of quartz, orthoclase, microcline and oligoclase, embedded in a matrix proportionately less in quantity and composed chiefly of chlorite and sericite. The fragments are nearly equal in size and show no pronounced rounding. The greenish colour is owing mainly to the large amount of chlorite present in the matrix.

To the north, and in ascending order, this rock is succeeded by a somewhat coarse-grained sandstone or grit, which forms the point immediately north of the mouth of the Little river. It also extends across the lake, occupying a corresponding promontory on the west side, known as Blueberry point. On both sides of the lake the rock occurs in thick massive beds, the stratification being shown only by the occurrence of conglomerate bands disposed in a somewhat constant direction. The rock is much jointed and broken, the fragments having a rough rhombohedral outline. To the north it is concealed in great part by the deep and extensive sand and gravel deposits that form the narrows opposite the Old Fort, but occasional outcrops may nevertheless be noticed. The rock extends along the east shore of the lake nearly three-quarters of a mile northeast of the Narrows, where it reposes directly on a massive red biotite-granite, although the actual junction is concealed. To the south of the narrows the rock occurs either in horizontal beds or dipping at a low angle to the northwest, but north of the narrows it seems to dip S. 35° E. $< 20°$.

A specimen obtained from a point composed of this rock about half a mile east of the Old Fort is a pale yellowish-green coarse-grained quartzite or grit. The thin section under the microscope shows it to be composed of quartz and feldspar embedded in a groundmass made up of pale yellowish-green sericite, for the most part present in exceedingly minute scales.

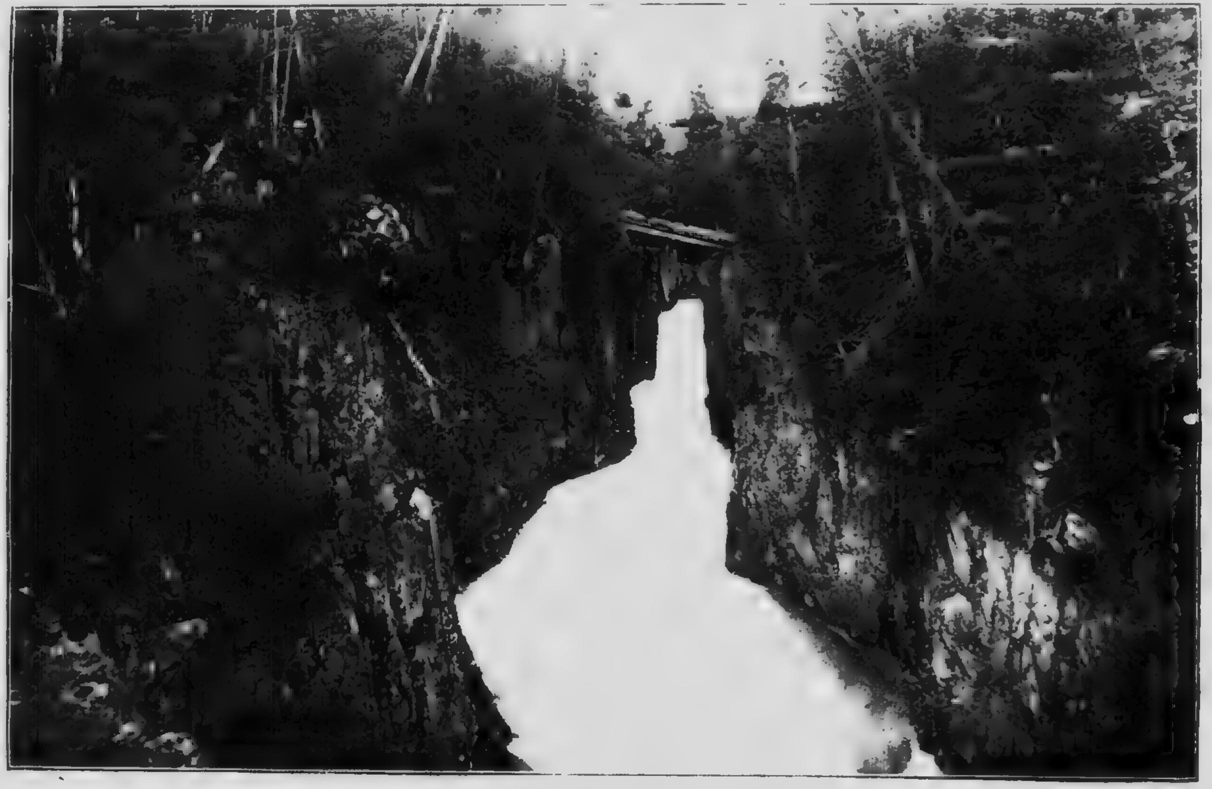
The granite which replaces the quartzite to the northeast of the narrows is exposed on both sides of the lake. It forms the western shore as far as Paradis bay, a distance of about four miles, and extends from half a mile to a mile inland. On the east side it composes Wine point and the southern shore of Kelly (Priests) bay, extending for a short distance west of the steamboat wharf to the point already mentioned, about three-quarters of a mile northeast of the Old Fort narrows. In all, these granite exposures cover roughly an area of six miles. Microscopically the granite is rather coarse in texture and of a deep flesh-red colour, owing to the marked predominance of the feldspathic constituents, all of which have been abundantly stained by iron.

Several small areas were noticed which have assumed a greenish colour owing to the epidotization and sericitization of a portion of the feldpsar; but such decomposed portions are proportionally insignificant, and the whole mass of the rock is extremely uniform, not only in colour but in the relative abundance and mode of development of its mineral constituents. The quartz occurs for the most part in somewhat rounded though irregular isolated areas, giving to the rock a conglomeratic or porphyritic appearance, a fact noted by Sir William Logan on the manuscript map embracing his survey of this lake made in 1845. Indeed the rock at first glance presents a marked resemblance to some of the brick-red quartz-porphyrites of Lake Superior. The ferromagnesian constituent is present in very small quantity and is now almost wholly converted to chlorite, the deep green colour of this mineral being probably the reason that the rock has hitherto been described as a hornblende-granite.

On previous geological maps covering this area this granite received the coloration usually applied to an acid eruptive, and as nothing was stated to the contrary it was very naturally inferred that, as such, it was of later age than the Huronian clastics with which it is associated. Sir William Logan in his early report does not give any details of its relations with the neighbouring stratified rocks, but only speaks of it as 'interrupting' the sandstones on Lake Timiskaming. During the progress of the present survey a detailed examination was made of the line of junction between this granite and the quartzite-grit. The best locality for investigating the various contact phenomena is situated in the small bay immediately west of the steam-boat wharf at Baie des Pères. In addition to the observations made on the ground a large suite of specimens was obtained illustrative of the line of junction for microscopic examination.

The facts obtained indicate the derivation of this quartzite-grit or arkose from the disintegration, *in situ,* of the granite, and are believed to form an almost unique example of the recognition of a portion of the original granitic floor upon which the Huronian sediments were deposited and from which they were derived.

In the vicinity of the line of junction between the two rocks the arkose or quartzite may be seen dipping away from the mass of the granite at a very low angle. The massive and jointed character of the beds of the arkose render it impossible to ascertain exactly all the minute details of the structural relations, but it is clear that the quartzite originally transgressed upon the surface of the granite almost horizontally. The granite has been unequally eroded and truncated, so that the present line of contact between the two rocks is undulating and irregular.



THE NOTCH OR GORGE, NEAR MOUTH OF MONTREAL RIVER.

4330 Huronian greywacke slates, much jointed and broken

From a distance the line appears to be sharp and abrupt, the greenish colour of the quartzite showing up very clearly and distinctly in contrast to the red colour of the granite. A closer inspection, however, showed that there is a gradual passage upward and outward from the main granite mass to the overlying arkose. Macroscopically this passage consists in a gradual loss of the red coloration of the unaltered granite and the progressive appearance in its arkose of a yellowish-green hue, although along the immediate contact there is no visible change in the position of the constituent minerals.

Thin sections of the least altered portions of the granite exhibit a normal holocrystalline hypidiomorphic structure, with a tendency to idiomorphic development on the part of the plagioclase. The rock is a rather typical biotite-granite.

The quartz is somewhat cracked and the feldspar and biotite are more or less altered, but the rock, as a whole, is fairly fresh, and neither dynamic nor chemical forces have acted on it to such an extent as to render its true character and origin doubtful.

The junctions between the grains of the various minerals are sharp with no interstitial granulated material. The quartz is the ordinary granitic variety and is filled with minute inclusions, frequently arranged in irregular interlacing bands. Many of these, when highly magnified, prove to be cavities filled with fluids and often containing movable bubbles. The larger quartz grains under polarized light are seen to be made up of an aggregate of smaller grains with differing orientation, and the quartz has a distinct but not excessive undulatory extinction. The predominent feldspar is generally microcline, which can be seen in all its various stages of development from grains exhibiting only an indistinct moiré structure (Plate V., fig. 2), to those in which the cross hatching is perfectly developed (Plate V., fig. 2). The former, however, are the more abundant. It is turbid and much stained with iron oxide.

Plagioclase is as a rule quite abundant, and as already remarked exhibits a tendency to idiomorphic development. It is frequently embedded or intergrown with the orthoclase and microcline. The individual sections are broad and tabular, parallel to M., and show in great perfection the fine striation due to multiple twinning. Their outlines are more or less rounded. Carlsbad twins appear to be rare, but were occasionally observed. Zonal structure was noticed in only a very few instances and then was not at all pronounced. Like the orthoclase and microcline this feldspar is turbid in consequence of incipient alteration, and little scales of sericite are scattered through it. Inclusions of biotite are not infrequent. Bending of the twin lamellæ is rare, and exists only in a very slight degree. The mean of several determinations gave about +10° as the extinction-angle measured on M., between adjacent lamellæ, showing the feldspar to belong probably to the acidic end of the oligoclase series. As usual, where alteration is commencing, it shows itself in the centre of the crystals.

Biotite was the only ferro-magnesian constituent noted in the section. It forms irregular plates and flakes which are considerably altered to chlorite. The original brown colour of the material has been changed to a light-green, but without entirely obliterating the optical characters of the biotite. Inclusions of ilmenite with leucoxene are common. The mineral is not very abundant in this particular section.

Ilmenite is the iron ore present in the rock, always accompanied by its alteration-product leucoxene, and in some instances immediately associated with zircon and apatite crystals. Occasionally it may be observed replacing titanite, skeleton forms of the latter mineral, with sharply defined acute rhombic outlines, being filled with a mixture of carbonates, ilmenite, &c.

Chlorite is present in the rock as the final stage of alteration of the biotite.

A few irregular grains and crystals of zircon with well-defined zonal structure were noted, and exhibited the usual optical characters of the species.

Apatite is also present, but is not very abundant, occurring in small crystals and irregular grains.

Sericite, or an allied hydrous mica, is present in minute scales and flakes scattered through the feldspar, as the result of their alteration. Red oxides of iron are abundant.

At the other extreme the derived arkose or quartzite-grit show distinctly rounded and water-worn fragments, chiefly of greyish translucent quartz, varying in size from those only microscopically observable, to others which are sometimes an inch in diameter and are arranged in layers, which have evidently resulted from a sorting of the material by water action. These fragments are embedded in a groundmass or cement varying greatly in proportionate quantity and composed of a confused mass of minute sericite scales, being the argillaceous product of the decomposing feldspar.

The series of thin sections studied represent the various stages in the process of the degradation of the granite, in consequence of which the overlying arkose has been produced. The first step shows the development of microcline at the expense of the orthoclase, accompanied by an incipient sericitization of the feldspars, which is noticeable, to a considerable extent, even in the least altered specimens.

This is accompanied by marked alteration of the biotite to chlorite, the development of a distinct undulous extinction in the quartz and a cracking of some of the individual grains. A further stage is reached when the quartz is accompanied by the occurrence of mosaic-like areas between the larger grains, while these latter show very pronounced strain-shadows. The plagioclase likewise shows more frequent evidence of pressure in its twinning, the lamellæ often in these cases ending abruptly against cracks traversing the crystal. Bending of the lamellæ is more frequent, while the alteration of biotite to chlorite is more complete, and is frequently accompanied by the deposition of iron ore between the flakes.

This is closely followed, marking what may be called the third step in the transition, by an appreciable advance in the alteration of the feldspar, especially of the plagioclase, which becomes traversed by a series of cracks filled with sericite, the alteration extending outward into the main mass of the individual grains; but there is still no evidence of motion or shoving apart of the fragments.

A fourth and somewhat sudden advance appears when the alteration of the feldspars has proceeded to an extreme degree, while certain fragments have been shoved apart. Each individual grain still occupies the same relative position with regard to the other mineral constituents, but in places portions of quartz and feldspar, especially the former, can be noticed to have changed their position along certain cracks traversing the grains, the portions, however, being never widely separated. The plagioclase has been almost completely saussuritized, leaving the unaltered quartz grains in almost the original position occupied by them. The microcline and orthoclase, though badly decomposed, have not undergone such complete alteration as the plagioclase. The fifth stage is reached when both orthoclase and microcline have undergone somewhat complete decomposition, some of the individuals being now represented by an intricate mass of their alteration-products. This is accompanied by markedly uneven extinction in the quartz-grains, as well as by a cracking and separation of quartz and feldspar-crystals, which is more evident in the former.

The sixth and final stage in the process shows that the feldspars have almost entirely disappeared, although occasionally irregular cores of the unaltered mineral remain. The groundmass is now seen to consist of a fine-grained sericitic material, in which are embedded sharply angular or sub-angular fragments with very pronounced undulous extinction. The whole appearance of the rock, both in the hand specimen and under the microscope, is that af a typical clastic (arkose). There is every evidence, however, that much of the material has not undergone any very wide separation, while the quartz fragments still preserve a tolerably sharp outline, showing no pronounced water-action.

The suite of specimens obtained exhibits a still further stage, representing the whole process leading to a final assortment and rearrangement of the degraded material by water into bands of differing coarseness, and resulting ultimately in the formation of somewhat typical grits and conglomerates. The change has evidently been first mainly a chemical one, primarily attacking the biotite, then the plagioclase, microcline and orthoclase and leaving the quartz alone comparatively unchanged. The rock thus softened and loosened by decomposition has offered a less effectual resistance to the process of disintegration, the process ending finally in the complete breaking down of the surface of the granite mass and the formation of the overlying arkose.

The latter rock forms the western shore of the lake between Paradis and Martineau bays, opposite Bryson island, where it constitutes perpendicular cliffs that rise from 150 to 200 feet, while the hills immediately behind continue with a more gradual upward slope representing a considerable additional elevation. The rock occurs in almost horizontal beds striking with the lake, the structure seemingly representing a very shallow and narrow syncline; the beds near the southern part of the exposure in the vicinity of Paradis bay dipping west, while those near Martineau bay dip east or toward the lake. Almost the entire eastern shore of the lake, as well as Chief, Drunken and Bryson islands, is composed of this greenish quartzite or arkose, excepting only some small patches and strips of Silurian limestone, elsewhere described.

This greenish quartzite is remarkably homeogeneous, generally presenting the characters of a coarse quartzose sandstone or grit, but occasionally, as on Drunken island, becoming finer-grained. It is very hard, resisting well the general influences of weather, and occurs in thick and much jointed beds, generally of a pale yellowish-green colour, weathering in some cases to a light-brown to a depth of about an eighth of an inch. It sometimes has a brownish-green colour, in which case the exposed surfaces gradually assume a yellowish-green colour, and in occasional exposures it has a light-greyish tint with irregularly disposed spots or areas of a greenish colour.

In the vicinity of the narrows between the eastern shore and Bryson island, the rock dips N. 22° W. < 3, and for the most part runs in low broad undulations. At a point on the east shore about one mile and a quarter south of Wright's mine this rock is seen directly superimposed upon the hummocky surface of a very massive breccia-conglomerate. The latter holds the usual pebbles of eruptive material, chiefly granite and diabase, and the chloritic matrix is very subordinate in quantity. The exposure presents a well rounded and glaciated outline sloping at an angle of nearly 60° to the north. At the summit, about forty feet above the water, the greenish quartzite seems to rest directly upon the conglomerate, presenting none of the usual transitional slaty or greywacké beds. The beds of quartzite seem to run in a somewhat undulating though approximately horizontal manner, apparently conforming with the line of outcrop of the conglomerate.

About three-quarters of a mile north of Wright's mine, on the same shore, there is a very interesting section showing the usual breccia-conglomerate at the base, very massive, and giving little or no structural detail. In ascending, however, it passes into a breccia, somewhat similar in colour and composition, but in which the lines of stratification can be readily distinguished. This is in turn succeeded by a fine-grained, brownish, well banded greywacké-slate, some portions of which cleave readily parallel to the bedding. This contains some smaller intercalated bands of the breccia, in which diabase and quartz fragments prevail. This is in turn overlain by another bed of conglomerate that passes upward into the yellowish-green quartzite-grit. The dip of these strata is to the northwest, at an angle of 10°, and the whole thickness of the section exposed is about fifty feet. The point immediately south and west of Wright's mine is likewise composed of the breccia-conglomerate, filled with pebbles of eruptive material, and the lode itself is situated in a similar though finer rock. In many instances the chloritic matrix is seen to wrap or flow around the enclosed fragments.

From Martineau bay northward, for about two and a half miles, the western shore is composed of a dark-greenish or greenish-grey, medium textured diabase. For nearly the whole of this distance this rock rises into cliffs, sometimes 200 feet high. The mass of the rock is much jointed and broken, and some of the jointage planes traverse it for considerable distances, thus simulating the basaltic structure so frequently assumed by similar basic eruptive masses. Under the microscope this rock is seen to possess a typical diabasic or ophitic structure, the interlacing idiomorphic laths of plagioclase penetrating the allotrimorphic individuals of augite. The plagioclase has been rendered more or less turbid by the development of the usual saussuritic products of decomposition, but many individuals still retain their clear and limpid character. The augite has, however, been altered to hornblende, the alteration being first to the fibrous form (the more abundantly represented), and then into the compact green trichroic variety, which is occasionally present. In some cases decomposition has proceeded so far that chlorite has resulted. A small quantity of unstriated feldspar in broad, irregular areas, that may be orthoclase, was noticed, while a considerable quantity of quartz fills in the interspaces. Occasional flakes and scales of brown biotite are likewise present, at times altered to chlorite. The ilmenite is almost entirely altered to leucoxene, although undecomposed portions remain. This diabase constitutes the vertical cliffs known as the Manitou or Devils rock, forming the shoreward extension of a huge mass that occupies the intervening area between Lake Timiskaming and the Montreal river, and which, extending across this river, forms a considerable strip on its southwest side. It also composes the area to the northwest, extending to the shores of Portage bay, on Bay lake, and beyond.

To the north of this diabase, on Lake Timiskaming, the characteristic breccia-conglomerate again comes in. The finer portions of the matrix are composed of a much hardened chlorite-slate or greywacké, while coarse-grained varieties resemble in appearance a diabase-tuff. The pebbles are usually abundant, and some of these resemble the diabase with which this rock is associated. Other pebbles are of quartz, and some are of a dark-grey compact felsite or greywacké, while a few consist of a pale-yellowish, fine-grained hälleflinta-like rock. Near a clearing on the west shore, a little south of Percy island, the rock exhibits a similar fine-grained chloritic groundmass, containing very numerous small fragments, chiefly of feldspar, while the rock itself as a whole greatly resembles a chloritized tuff or trap ash.

This is succeeded to the north (and doubtless in ascending order) by a fine greenish compact slaty greywacké, exposed in the vicinity of Farr creek, that continues beyond Lawlor's farm. For about two miles in the vicinity of Haileybury the western shore is occupied by Silurian strata. About two miles north of Haileybury the basal bed of the Silurian, consisting of a coarse grit or conglomerate, rests unconformably on the mammillated surface of the compact green slate of the Huronian.

This slaty rock, near the junction between the two formations, is very much hardened and presents alternating bands of greenish and brownish colours, so frequently characteristic of the middle member of the Huronian of the district, and these bands have a general direction of S. 70° W. The shore-line where the rock outcrops is more irregular than that to the north or south, with two small off-lying islets. About a mile north of the contact the slate passes into the breccia-conglomerate, containing many pebbles and boulders of greyish slate, compact quartzose and hälleflinta-like rocks, and pebbles of diabase of varying degrees of texture. The matrix in which these fragments are embedded is, as usual, dark-green in colour, while the whole mass of the rock presents little or no evidence of stratification. In general, however, it may be stated, with some degree of confidence, that the structure exhibited on the shore from the contact to the south as far as the diabase mass is that of a shallow syncline, the breccia-conglomerate forming the basal beds with the slates superimposed without break.

Where the fragments are abundant in the conglomerate there is frequently present a considerable amount of pyrite, which in some cases acts as a sort of cement, enclosing these fragments. The oxidation of this pyrite and its subsequent removal has left a series of rusty cavities that are rather characteristic of these outcrops.

The last exposure that may be mentioned here is one of the breccia-conglomerate which occurs on the northeast shore of Sutton bay, forming hills that are rather conspicuous and rise from a somewhat extensive marshy flat. The rock presents the usual dark-green chlorite groundmass. This matrix encloses larger pebbles of red and grey granite, green diabase of several varieties and degrees of coarseness, and some fine-grained compact greywacké-slate, with a few of grey quartz. The larger fragments, especially those of granite, possess more or less rounded outline, while most of the smaller fragments, and especially those representing basic eruptive material, are decidedly sharp and angular. The rock is massive and for the most part structureless, but planes that possibly represent the original bedding dip N. W. < 25°.

RIVER AND LAC DES QUINZE.

The River des Quinze doubtless received its name from the fact that fifteen portages have to be made between Lake Timiskaming and Lac des Quinze, but this number may be diminished under some circumstances. Although the stream presents considerable stretches of deep water with little or no current, it is, as a whole, wild and turbulent. The river has a general east and west direction, and in a straight line is about thirteen miles long, although this distance is increased to eighteen miles by means of flexures. It enters the northeastern corner of Lake Timiskaming in a shallow indentation known as Paulson bay. With the Blanche, which reaches the lake a little over a mile farther west, it forms a delta with low marshy islands, and only two channels can be utilized for purposes of navigation. The more easterly of these two channels is seldom used on account of its being extremely shallow, while the western or main channel is of good depth. About half a mile from the lake a rather narrow and crooked, though deep and navigable, channel joins the Quinze with the main portion of the Blanche. This is known as the Chenal du Diable, and during freshets the waters of the Blanche follow this channel to the lake, but during the summer months the current in this channel is reversed, and a considerable portion of the waters of the Quinze reach the lake by this somewhat circuitous route.

The River des Quinze is generally a little over a mile wide. The banks, especially on the northwest side, are low and liable to inundation. The southeast bank is somewhat higher at Miller point, with a hill of gravel and boulders.

In ascending the river the first rock-exposure is on some small islets nearly opposite the North Timiskaming P. O. (McBride's). The rock is the breccia-conglomerate of the Huronian, the matrix being a very compact, fine-grained material of dark green colour, through which are disseminated occasional pebbles as well as angular fragments of the greyish granitic rock. There is little or no evidence of stratification. The further ascent of the river exhibits a corresponding rise in the geological scale. The first three rapids come very close together and are not more than a mile in all. The first and second rapids each show a descent of about twelve feet. The third has a fall of about sixty feet and is one of the worst on the river. The rock exposed at the several portages is a dark-grey micaceous slate, the cleavage or foliation planes, which are the only distinct structure exhibited, showing abundant small black scales of biotite.

There are many lighter coloured streaks running through the rock, more or less parallel with one another, which seem to be composed mainly of feldspar and quartz. These occur in irregular curving and often branching and lenticular areas giving a decided foliation to the rock. They do not appear to represent coarser and more quartzose bands of the darker coloured slates with which they are associated, but are more or less veinlike in structure and secondary in their origin. The strike and dip could not be ascertained with any degree of certainty, but the rock, from its lithological character and apparent stratigraphical position, represents the lower portion of the slate, or middle member of the Huronian, overlying the breccia-conglomerate noticed as occurring near the mouth of the river.

Above this third portage there is an interval of three miles of deep unobstructed navigation to the fourth rapid, immediately above the mouth of Tiger creek, an important tributary coming in from the north side. The river is here divided into several channels by rocky

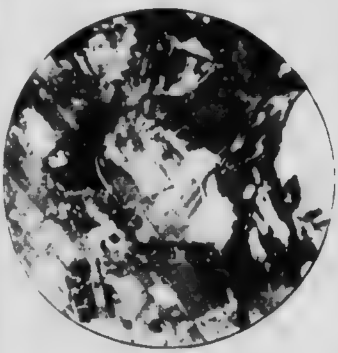


FIG. 1.

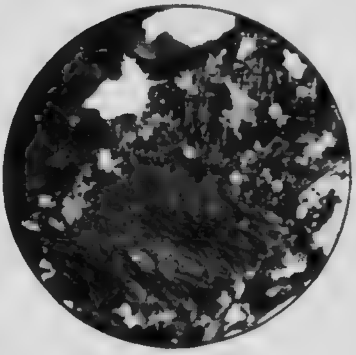


FIG. 2.

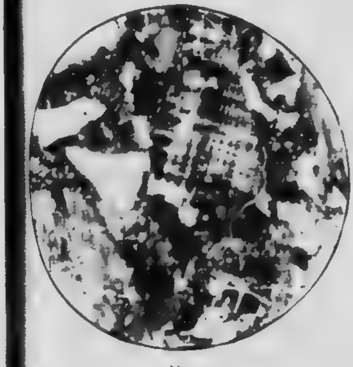


FIG. 3.

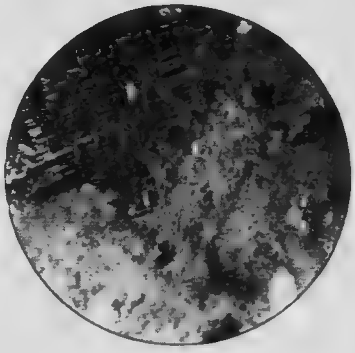


FIG. 4.

1. Biotite granite or granitite, near Cedar point, east side Lake Timiskaming: orthoclase, plagioclase and chloritized biotite. 52.

2. Effects of pressure, granulation, and the formation of microcline in arkose, near Baie des Lake Timiskaming. 52.

3. Formation of microcline and moving apart of minerals, of arkose resulting from degradation ite, near Baie des Peres, Lake Timiskaming. 52.

4. Decomposition of feldspar (microcline) *in situ*, forming arkose, near Baie des Peres, Lake ming. 52.

islands, the largest of which, Mann island, is nearly one and a half miles in length. The main channel which runs to the north of this is one long succession of heavy rapids with a total fall of about eighty feet. The portage-route, about two miles long, follows the north bank.

On this portage the rocks met with are dark greenish-grey slate, much cleaved and jointed and probably dipping to the southeast. In places they show considerable alteration and development of sericite, the alteration being greatest near the eastern end of the portage. These slates continue to the upper end of the island where they are interrupted by a mass of uralitic diabase and amphibolite, about three and a half miles in breadth, which extends southward and is probably continuous with similar rocks exposed in the northeast corner of the township of Duhamel and the eastern portion of the township of Guigues. This rock is often massive, but not without traces of foliation, and towards the eastern limit it passes into a distinct greyish-green amphibolite, in which considerable mica has been developed. Under the microscope it is found to be composed chiefly of plagioclase and hornblende, and thus to be classed with the diorites, but it evidently was originally a diabase, as a well marked ophitic structure is still apparent. The augite originally present is almost wholly converted into hornblende, while during this process of uralitization, as is usual, a considerable quantity of epidote has been developed. It is a straw-yellow colour, exhibits strong pleochroism, and has often fairly good crystallographic outlines, although occurring mostly in irregular grains and patches associated chiefly with the hornblende.

The process of uralitization is here very interesting. The augite alters first into a compact green trichroic hornblende. Where it has suffered most from dynamic action a fibrous variety of hornblende (actinolite) has resulted, which has in turn decomposed into chlorite that still preserves much of the pleochroism of the hornblende. Between crossed nicols the matted aggregates of scales of chlorite show collectively the deep-blue polarization-colour so often exhibited by it. Much of the plagioclase is remarkably fresh for such a decomposed rock, but a great deal of it shows a somewhat advanced saussuritization, the resulting epidote, zoisite and sericite being especially abundantly developed where the rock has been most squeezed. Ilmenite occurs in aggregates of small grains which are each surrounded by a rim of leucoxene. Quartz, although present, is not at all abundant. Where pressure has been greatest the rock passes into a typical hornblende-schist or amphibolite. The ophitic structure cannot be detected under the microscope, while pressure has caused the breaking up of the original bisilicate individuals, so that they are now represented by many small shreds and fragments, arranged with a more or less parallel alignment. A great deal of epidote has been developed, while the ilmenite originally present has been almost converted into a brownish sphene, now seen in irregular grains or aggregates of grains scattered through the rock. Associated with and apparently caught up in this eruptive are certain small patches of sericitic and epidotic slates, while on one portage (the tenth from Lake Timiskaming) an interlamination of light and dark-grey quartzite with red jasper and magnetic iron ore occurs, the whole running parallel with the foliation of the enclosed rock, N. 20° E., and dipping N. 70° W. < 70°.

Above Mann island the seventh portage from the lake is merely a lift over a rocky islet to avoid a small rapid in the river. A short distance farther up the next or eighth portage is reached. This is but a short carry across to a small lake to the northeast of the river and a short paddle across this brings us to the outlet at its east end. Another short portage along the bed of this outlet comes out again to the main stream. Above this is a sharp turn in the river, its direction changing abruptly to a southeasterly bearing. The canoe-route again leaves the main stream below this elbow, a very rough portage on the southeast side leading to a narrow lake about half a mile in length. The next portage, divided into two carrys by an intervening pond, counts as the eleventh and twelfth, leading back to the main river. The route thus follows a narrow valley running parallel to the river, avoiding a very rapid stretch of river, with a total fall of about fifty feet. The direction of the river here coincides with the foliation of the hornblende-schists. The thirteenth portage is on the east side of the stream, and is sometimes called Cypress portage. It is over half a mile in length and is occasioned by a rapid with a fall of over twenty feet.

Toward the head of Cypress portage the uralitic diabase, largely changed into a rather typical hornblende-schist, is penetrated by small stringers composed chiefly of flesh-red feldspar and grey quartz, with occasional small fragments of hornblende. The connexion of these small apophyses of granitic material with the larger parent mass of hornblende-granite-gneiss exposed farther east was clearly established, and these lenticular patches of quartzo-feldspathic material become more abundant as the vicinity of the granite-gneiss is approached. The rock contains considerable secondary biotite, developed chiefly along the planes of shearing, and this, in conjunction with lighter feldspathic bands, produces a very distinctly foliated rock. The foliation dips westwards at a high angle, generally about 50°.

The same rock continues, with the interfoliation of lighter and darker bands, across the fourteenth or Maples portage, at the head of which the course of the river turns rather abruptly to an easterly direction while the width is increased to a quarter of a mile. The dividing line between the hornblende-schists-gneisses crosses this lake-like expansion obliquely. Although the actual contact is not exposed the two rocks are seen within a very short distance of one another, both striking toward the northwest, while the dip of the foliation is to the southwest at an angle of about 50°. The junction between the two is evidently one of intrusion, the granite-gneiss piercing the amphibolite in the form of the small interfoliated pegmatite streaks and patches above described, and it appears that the irruption of the hornblende-granite-gneiss was the cause of the foliation and alteration of inceptive diabase, producing the hornblende-schist.

The granite-gneiss just alluded to is a reddish, very distinctly foliated rock, the foliation being determined by the more or less parallel disposition of the fragments and individuals of hornblende. The thin section shows the rock to be composed essentially of orthoclase, microcline, hornblende and quartz, with sphene, epidote, zircon and apatite as accessory or accidental constituents. Much of the orthoclase occurs as irregularly shaped individuals or phenocrysts embedded in a finer-grained mosaic composed of broken up fragments of feldspar and quartz. These smaller fragments very often assume the microcline habit, which is evidently the result of pressure. The larger orthoclase individuals show considerable alteration, especially in their central portions, and although in some cases they exhibit tolerably sharp and perfect crystalline outlines they are usually more or less jagged, owing to the breaking up of their borders to form part of the finer-grained mosaic. The hornblende is dark green, trichroic, and occurs in irregular shreds and fragments having a marked parallelism. The sphene is deep brown in colour, and occurs in characteristic wedge-shaped crystals. The epidote is evidently of secondary origin, and is present in irregular grains and masses of a deep straw-yellow colour and strong pleochroism. Zircon and apatite are in small acicular prismatic crystals. The reddish colour is imparted by the presence of iron-oxide, which fills the cleavage-cracks of the feldspar as well as the minute fissures present in the rock itself.

This rock continues as far as Lac des Quinze, but near the lake it becomes coarser in texture and more highly porphyritic, the reddish crystals of orthoclase being frequently as much as half an inch in diameter. The foliation is rather obscure, but on the lake itself is more evident.

The fall overcome by the last or fifteenth portage before reaching the lake is about ten feet.

Lac des Quinze takes its name from the river. The general summer level of this lake, as determined by the mean of a large number of aneroid readings, is 848 feet above sea-level. The area of the lake is approximately forty square miles. A considerable portion of the northern part of the lake is, however, not represented on the accompanying map. There is a Hudson's Bay trading post on the lake, known as Long point, while lumbermen now at work in the country near Lake Winnowaia or Expanse, a little to the east of the present map-sheet, have several farms or clearances, and depôts for supplies.

The main body of the lake extends to the southeast from the outlet for a distance of about eight miles, with an average width of a little over a mile. A second, generally about a mile wide, runs northward for a like distance from the outlet and then divides into two bays, which continue with the same general direction for about three miles farther, the more westerly of the bays being the one followed in going to Lake Abitibi. About two miles to the east of the north arm a second narrow inlet extends to the north for about three miles. From the southeastern extremity of the main body of the lake two arms branch off. The larger one runs to the northeast for about fifteen miles, gradually tapering to a point, where it receives the Upper Ottawa. The second arm runs to the southward for about five miles, and at its southeasterly corner reaches the western terminus of the road from Baie des Pères. A new road from Lake Timiskaming to Lac des Quinze, to the north of the River des Quinze, starts from the foot of the first rapids, but is not yet completed.

The several arms of the lake have all been eroded in a direction corresponding with that of the foliation of the gneissic rocks, and evidently represent the more schistose and least resisting belts of these rocks. The prevailing rocks are grey granitic and dioritic-gneisses, the latter containing usually a considerable proportion of biotite in addition to the hornblende, and with an increase in the abundance of the bisilicates, passing into an almost black, glistening amphibolite, in which the schistosity is always well marked. Quartz is present in considerable quantity, particularly in certain bands and epidote was also noticed as a somewhat abundant constituen At several points on the lake massive crystalline diorite was observe The gneisses have a well marked foliated structure, the inclination of this foliation varying from 30° < 45° in a westerly or northwesterly direction.

LAKE KIPAWA.

The name Kipawa means, freely translated, 'a very narrow passage between steep rocks,' and refers to the presence of a gorge in the northern part of the lake, now generally known as the 'Canal.' The lake is very irregular in form and full of islands. In general the lake may be described as filling several valleys approximately parallel to that occupied by the southern portion of Lake Timiskaming. The general trend of these valleys, like that of Timiskaming, cuts across that of the foliation of the gneissic rocks, except in those portions of the southeast of Roche à Corbeau and the Beauvais narrows, where the main direction of the lake corresponds rather closely with the foliation of the adjacent gneisses. The greatest length of the lake, from Chemagan bay on the north to the portage leading out of Jeanbeau bay on the south, is almost thirty-two miles, on a line bearing S. 12° E. It may be said to be divided into two main portions occupying an approximately parallel position, each, however, branching off in bays and arms in various directions. These two larger portions are connected about the centre by a few comparatively narrow channels. The portion to the southwest, extending from the outlet at the northwest end of Sandy Portage bay to Jeanbeau bay, measures twenty-seven miles in a direction of S. 38° E.; while the large body of water to the northeast, reaching from the northwest end of Taggart bay to the outlet of Hunter lake, a distance of twenty-eight miles, has a general trend of S. 42° E. The area of Lake Kipawa, including the islands, is nearly 120 square miles. Its height above sea-level varies from 876 to 886 feet. The Kipawa river, its natural outlet, is a crooked and rapid stream which enters Lake Timiskaming a little over six miles below the Montreal river. The lumbermen have, however, built a dam across the Kipawa at the northwest end of Sandy Portage bay, thus raising the water-level. The rocky obstructions between the southwestern part of Lake Kipawa and the ponds at the headwaters of Gordon creek having been removed, a large portion of the Kipawa waters now discharge by this artificial channel. In this way the "drive" for logs is much shortened and the water held back until required.

The greater part of the shore-line of the lake is somewhat high and rocky, the surface being often strewn with large boulders, chiefly of the underlying gneissic rocks.

There is little level land, although clearances have been made and farms cultivated in connexion with lumbering. Most of the white pine of first quality has been cut, but the shores are still beautifully wooded.

Of the very numerous islands McKenzie and Karl islands are the largest, the former being a little over five miles in length and averaging about two miles in breadth, while the latter is scarcely half thi size, measuring a little over two miles in length by about a mile and a half in width.

The "Canal," already mentioned as giving its name to the lake, is a picturesque feature, being a narrow gorge about a quarter of a mile long with perpendicular walls of gneiss, situated about a mile northwest of Mackenzie island, and it leads into a couple of small lakelets or expansions.

The rocks so abundantly exposed along the shores and islands of Lake Kipawa are remarkably uniform in composition and macroscopical characters. They are typical examples of "gneisses," being, as a rule, very distinctly and evenly foliated, and exhibiting darker and lighter-coloured bands of more or less basic character. The more acid bands are usually of greyish, reddish grey or flesh-red colour; while the more basic bands are of varying shades of darker grey, becoming almost black in certain instances. The lighter-coloured phases are, perhaps, the most abundantly represented, and besides occurring as interfoliated bands associated with more basic material, these in themselves constitute the greater portion of somewhat important and extensive rock-masses. Under the microscope they are seen to contain orthoclase as the prevailing feldspathic constituent, and biotite as the principal and often the only ferromagnesian mineral. They must, therefore, be referred to as biotite-granite or granitite-gneiss. Besides these microcline is usually abundant, together with some plagioclase (usually oligoclase). A large amount of quartz likewise accompanies the feldspar. The biotite is, as a rule, fresh and of a deep brown colour, occasionally showing alteration to chlorite. A little muscovite (most of which is of secondary origin), sometimes occurs, but not in sufficient quantity to characterize the rock. Besides these, smaller quantities of epidote, sphene, sericite, chlorite, apatite, zircon, magnetite, and sometimes allanite, are usually present.

Occasionally somewhat darker and more basic portions are seen to contain a compact dark-green trichroic hornblende in addition to the biotite, the rock thus becoming a hornblende-granitite-gneiss. These portions are usually of a dark-grey colour, and show a very marked abundance of the coloured constituents.

The very dark-grey, almost black varieties, in which but little of the lighter-coloured minerals can be macroscopically detected, often show plagioclase as the prevailing feldspar, while biotite is replaced by hornblende, the principal ferromagnesian mineral, although biotite is likewise almost invariably present. The constituent minerals are essentially the same as those present in the more acidic phases, differing only in their relative proportions.

The structural relations of these rocks show that they form integral and inseparable portions of one complex, produced by differentiation during the slow cooling of a magma of more or less heterogeneous composition.

At the head of Gordon creek, and in the vicinity of Kipawa post-office, (formerly Norcliffe), the gneiss is very distinctly foliated, the strike being about S. 55° E., the dip S.W. $<$ 10° to 20°. The thick massive bands in the high bluff to the north of the railway terminus, representing the more acid portions of the rock, are granitic both in appearance and composition. Feldspars, both reddish and greyish, are present as well as quartz, and a very sparing quantity of mica. The quartz, besides being present in grains and areas distributed throughout the rock, also occurs as veins and masses, evidently representing the most acid form of the prevailing pegmatite.

On the northeast shore of the largest island of the group, situated about a mile east of Kipawa post-office, are good exposures of light-grey and pinkish-grey quartzo-feldspathic gneiss, alternating with darker bands which contain hornblende in addition to the more usual biotite. The strike is east-and-west, with dip to the south $<$ 35° to 45°. Along the shore the basic bands have been weathered out more easily than the acid ones.

Farther to the southeast, toward Jeanbeau bay, the gneiss varies in strike from S. 50° E. to S. 60° E. with a dip to the northeast $<$ 20° to 30°. North of Gordon creek the foliation of the gneiss corresponds rather closely with the trend of the shore-line, dipping to the northeast at varying angles. At Greenorton bay the schistose gneiss is very basic and contains hornblende in addition to the biotite. This rock also holds garnets and vein-like bands of smoky quartz. At the foot of Gibson bay the gneiss is of the common light-greyish granitite variety. On the south shore of Bryson island there are good exposures of a light-grey granitite-gneiss, the foliation being much contorted.

Beauvais narrows cuts the foliation of the gneiss at a considerable angle, the strike being S. 65° E. with a dip to the northeast $<$ 15° to 25°. On the south shore of Smith bay exposures of hornblende granitite-gneiss show the constituent feldspar much decomposed and a large part of the biotite altered to chlorite. At Fowler point a knoll rising about forty feet above the surface of the lake is composed of a fine-grained almost black quartz-mica-diorite. This rock contains irregular patches and stripes of a much more acidic gneiss, light flesh-red in colour, which seems to contain feldspar, quartz, biotite and garnet, with occasionally some muscovite and epidote. Near Edward depôt, on the north shore of Smith bay, the granitite-gneiss is as a rule very acidic, containing only small quantities of biotite. At Somerville point the gneiss is a reddish granitite much weathered and showing what appeared to be a very local strike of N. 40 E. The southwest shore of the lake opposite Sunnyside post office is composed of reddish granitite-gneiss, generally striking with the trend of the shore, but sometimes showing many local twistings. At Turtle portage the usual granitite-gneiss shows a beautiful curve in the foliation, the strike gradually turning from N. 80° E. to S. 60° E., with a prevailing southerly dip. At Hunter Lodge narrows and on Hunter lake the gneiss strikes about S. 60° E., dipping in a southerly direction.

Along the south shore of McLaren bay the gneiss is usually of a light-grey colour, rather fine-grained, micaceous and granitic in appearance, being tinged with iron-oxide. It usually shows a distinct though imperfect foliation on account of the comparative scarcity of bisilicate material. The strike is N. 82° E. and the dip to the south. Microscopically this is a typical holo-crystalline granitic rock or granitite-gneiss, consisting essentially of orthoclase, quartz and biotite, with apatite-zircon, sphene, a very little magnetite, much microcline and some plagioclase, (oligoclase) small quantities of secondary muscovite and epidote are also present.

At the south end of an island immediately east of McKenzie island there are exposures of the ordinary flesh-red granitite-gneiss. On the northwest shore of McKenzie island the hornblende-granitite-gneiss seems to change in strike from N. 20° E. to N. 50° E., thus conforming with the trend of the shore-line, while the dip is to the southeast at varying angles generally about 60°. At one point a vein of quartz (pegmatite) varying in width from six inches to two feet cuts the gneiss, of which it contains fragments. The gneiss here is well foliated and often locally twisted. The gneiss composing the cliffs on either side of the "Canal" contains a considerable quantity of quartz and is much weathered and stained. It has a strike of N. 65° E. with southerly dip< 80°. At the south end of Campbell bay the strike of the gneiss is north 62° east. A thin section of a specimen obtained from the western shore, about two miles south of the entrance, representing the most basic bands, showed the rock to be a quartz-mica-diorite-gneiss. The rock is nearly black, is evenly and distinctly foliated and exhibits glistening cleavage surfaces along the planes of foliation. Exceptional bands are of light pinkish-grey colour, feldspar being the predominant constituent.

Microscopically, this rock is composed of plagioclase, orthoclase, microline, quartz, hornblende and biotite, with epidote, sphene, apatite, zircon and some pyrite, more or less altered to limonite.

On the west shore of Karl island, as well as on the island lying to the southwest, the gneiss shows the usual variation from greyish to reddish, with interfoliated darker bands in which the biotite is more abundant. The strikes vary from N. 64° E. to N. 67° E., with dip to the south< 60° to 70°.

At one place on the north shore of the lake, half a mile north of the northeast point of Karl island, a very massive and coarsely crystalline porphyritic diorite is associated with the ordinary greyish granitite-gneiss. This rock is of a dark-green colour when fresh, but near the surface is decomposed for a depth of nearly two inches, the decomposed layers being much lighter in colour. Large phenocrysts of deep-green hornblende, some of which are an inch or more across, and most of which possess tolerably well defined crystalline outlines, are developed in a coarse-grained groundmass composed almost wholly of allotriomorphic individuals of dark-green trichroic hornblende, the small and irregular interspaces being filled with feldspar and quartz. Much of the hornblende includes dark schillerization products. The decomposed layer near the surface shows the somewhat abundant development of epidote at the expense of the hornblende, giving the prevailing yellowish-green colour to this portion of the rock. The whole exposure measures about fifteen yards long by twenty-five yards wide and is surrounded by the greyish granitite-gneiss, while several dikes of pegmatite varying from a quarter of an inch to six inches in width cut the diorite.

In the northern portions of Hay bay the prevailing rock is the ordinary granitite-gneiss, the strike of which varies from N. 60° E. to N. 70° E.

The rock exposed on the shores and islands of the bay running towards the outlet, the northwestern portion of which is generally known as Sandy Portage bay, is the usual reddish and greyish biotite-granite-gneiss or granitite-gneiss. The strike varies in general from N. 50° E. to N. 60° E., while the dip is to the northwest at high angles, generally varying from 65° to 85°. Near the outlet the strike turns more to the north, the foliation in this vicinity running about N. 40° E., while the bands are nearly if not quite vertical. At one or two points extremely basic portions of the gneiss were seen to be highly hornblendic, thus passing into quartz-mica-diorite.

MATTAWA RIVER.

The term Mattawa was first applied to the confluence of this river with the Ottawa. The river has also been known as the Petite or Little river, while to the Indians it was formerly known as the Tessouacsipi. It is really a succession of large deep lakes united by comparatively narrow and shallow rocky stretches. The total distance from the Ottawa to the western end of Trout lake, in a straight line, is about thirty-six miles, but following the river this is increased to forty miles. The direction is in general nearly east-and-west, following a continuation of the main valley occupied by the Ottawa below the confluence of the two streams. In ascending the Mattawa rapid water is encountered almost at once, the stream flowing over a shallow bouldery bed. This, together with a small rapid, a little over a mile above at the outlet of Boom lake, gives a fall in the river of about two feet.

Boom lake, the first expansion reached, is about a mile and a quarter long, and not over a quarter of a mile at its greatest width. At the upper end of this lake the river is contracted in two places to a width of less than a hundred feet and a fall of nearly twenty feet is occasioned by the Plein Chant rapids. Plein Chant lake, at the head of these rapids, is five and a half miles in length. The widest portion is near the eastern end, where it is about thirty chains, but this gradually diminishes westward, until, near the upper end, it is not more than three or four chains wide. In the widest portion a depth of over two hundred and eighty feet was found.

Between this lake and Lac des Aiguilles, the next expansion, the distance is a little over two miles, and four rapids intervene, with alternating stretches of still water; the combined fall is eighteen feet. The three largest rapids are known in ascending order as Les Epines, La Rose and Des Roches or Des Aiguilles. The Amable de Fond river, the largest tributary of the Mattawa, enters from the south side a short distance above the second rapid. Lac des Aiguilles, which is a little over a mile long and a quarter of a mile wide, is separated from the next succeeding stretch of river, lying parallel to it on the north side, by a rocky bar known as Les Aiguilles islands. The three narrow rocky channels formed by these two islands, even at high water, barely afford a passage to loaded canoes. The eastern one constitutes the main route, and a small rapid at this point shows a descent of a few inches. Above this is a long stretch of deep water that gradually diminishes in width. The river throughout this distance of two and a half miles is flanked on either side by almost perpendicular walls of gneissic granite.

At the end of this stretch the upward course of the river changes sharply to a southerly direction for about two miles, and presents a series of rapids with intervals of deep water, the total fall being fifty-five feet. The Chute des Paresseux, where the water falls thirty-four feet, is the first and largest of this series. Pimisi or Eel lake, (sometimes also called Penice bay and Moon lake), above these rapids, marks another change in the course of the stream, which from this place to the head of Talon lake trends northwesterly. Between Eel lake and Talon chûte the river flows for three-quarters of a mile through a narrow rocky cañon enclosed between perpendicular walls of granite. Talon chûte is the greatest single fall on the whole river, the water descending forty-three feet over a rocky ledge composed of massive flesh-red gneissoid granite. The main channel is on the north side, but in addition there is another though much smaller parallel passage. The downward extension of this passage is continued in a deep gorge which connects with the main channel a short distance below the falls, the whole apparently representing the erosion of a band of crystalline limestone that here occurs. About half a mile below Talon chûte a small rapid occurs with a descent of less than a foot, and a short distance above it is Talon lake. To the left, on entering the lake, a large bay runs westward for about three miles, Kab[illegible] bay, at the western extremity of which an important tributary (Kabiskow creek) enters, forming the outlet of Nasbonsing lake, a large and irregular sheet of water situated in the southern part of the township of Ferris.

Talon lake lies northwest and southeast, is about seven miles long and has in general a breadth of almost three-quarters of a mile. The shores are generally bold and rocky, although occasional small sandy flats occur. The general depth may be said to vary from fifty to one hundred feet, but in occasional spots a depth of two hundred feet and over was met with.

The connecting stream between Talon and Turtle or Lower Trout lake, the next expansion in the river, is about four miles. The stream leaves Turtle lake about a mile from the eastern extremity. It is shallow, rocky and rapid with some small intervening ponds of deeper water. Turtle lake lies nearly east and west and is about four and a half miles in length and not more than half a mile in width. Thence an ascent of barely a foot occurs, in a short channel, to Trout lake, at the summit. This is eight and a half miles in length with a greatest breadth, near the upper end, of about two miles. It is often over 200 feet deep, and the shores are rough and rocky. To the north of the lake a range of hills from three to four hundred feet high extends with [illegible] unbroken continuity to the mouth of the Mattawa river [illegible] northward and northwestward up the valley of the [illegible]

[illegible] the west end of Trout lake is only about three miles distant from Lake Nipissing, and the neck of land separating the two lakes is in general very level. The canoe-route usually followed to Lake Nipissing leaves Trout lake in a bay running to the south near its western end. The first portage runs over a ridge of sand. The Rivière de la Vase is then utilized all the way to Lake Nipissing, a distance of a little over six and a half miles. This small stream runs through low and often marshy ground most of the way, entering Lake Nipissing about six miles southeast of North Bay.

The land in the immediate neighbourhood of the Mattawa river is generally rocky, barren and unfit for agriculture. A short distance from this river, however, in the townships of Papineau, Calvin, Bamfield and Ferris, considerable areas have been cleared, and good progress has already been made in the settlement of these townships.

The rocks exposed along the Mattawa are for the most part massive reddish granitite-gneisses, the strike of the foliation running in a series of widely undulating curves in a general east and west direction with a prevailing southerly dip < 35° to 65°. Crystalline limestone is very sparingly present in assocation with these gneissic rocks, and wherever noticed the evidence seems to show that it has been caught up in the gneiss during the irruption of the latter. On the south shore of Talon lake, as well as in the southern channel at the falls, at the outlet of this lake, the crystalline limestone was found in association with a very massive indistinctly foliated granitite-gneiss, the intrusion and latter age of the latter being apparently clear. Near the western end of Nasbonsing lake the rock is a light reddish granite-gneiss composed chiefly of feldspar, with a small proportion of greyish quartz and a little black mica occuring in isolated areas of aggregated scales, together with numerous small garnets. The strike is to the northwest with a dip to the southwest, generally at a high angle. Near the eastern end of the lake the gneissic rocks present are more highly differentiated and occur in irregular curving bands which have a general strike curving gradually around from east to northeast.

On Trout lake the granitite-gneiss occurs in reddish and dark-coloured bands which have a prevailing direction of nearly east and west, gradually bending round to the northwest in the western part of the lake, while the dip is to the south < 45° to 65°.

Lake Nipissing.

This important lake has an area of 345 square miles, and is wholly surrounded by Laurentian rocks. Its main length is east and west, and its greatest length, from the shore at East bay, near Callander station to the western end of Bear bay (west arm), is sixty miles; while the greatest width, from Beaucage bay on the north to the mouth of the South river, is sixteen miles. The elevation above sea level, at different seasons, varies from 642·2 to 639·5 feet. The northern and eastern shores are in general low and for the most part present sweeping beaches of sand, separated by rounded points of rock. The water, for a considerable distance from the shore, is shallow. The west end of the lake has an irregular coast line with long arms and bays extending, and rocky islands. A great number of these islands screen the more open water outside, running in long lines, more or less parallel in direction with the peninsulas or points which divide the bays from one another. The islands, generally small, are sometimes several miles in extent. The southern shores are bold and rocky and the water is deep even in their immediate vicinity. The whole of the eastern end of the lake is wide and exposed, containing only two small groups of islands known as the Manitou and Goose islands.

The western end of the lake consists of four principal bays or arms, separated from one another by rocky promontories, their continuation towards the deeper water in the central portion of the lake being marked by the occurrence of long lines of islands and reefs. The most northerly inlet, McLeod or Goulais bay, has an almost direct north and south trend. It is about four miles in length by nearly two in breadth and lies immediately west of the marshy delta of Sturgeon river. The water in this bay is very shallow. A rather narrow and crooked channel, however, exists near the eastern shore, but is navigable only for very small steamers or tugs. Immediately southwest of this bay, and separated from it by the rocky peninsula ending in Goulais point, is another arm of the lake, divided to the west into two subsidiary bays, known as Northwest bay and Middle West bay respectively. Northwest bay is over four miles in length, with a width rarely exceeding a quarter of a mile, and having the general direction indicated by its name. Gradually tapering westwards it receives a small stream that drains some marshy lakes situated in the northwestern part of the township of Macpherson. Middle West bay is much less important, being only about two miles in length, and at the west end receives a small tributary known as West river, that drains the southern part of the township of Macpherson.

Of the indentations extending to the west, however, the largest is known as the West arm or Bear bay. The general trend of this extension is nearly east and west. An inspection of the accompanying map will convey a good idea of the close dependence of topographical outline on the strike of the foliation of the enclosing gneissic rocks. In many instances abrupt changes in direction are encountered, but these follow correspondingly sharp curves in the lines of foliation and cleavage. The width of the bay is very variable, alternately contracting into narrow straits only a few chains in width and opening again into wide expanses generally crowded with islands. In the eastern portion, for a distance of nearly eight miles, the average width is nearly two miles. The bay gradually narrows towards the west end where it receives the waters of a small stream, draining several important expansions to the west.

Several important streams enter Lake Nipissing. The largest is the Sturgeon river, draining about 3,000 square miles of country to the north and west, and joining the lake in the midst of a large marsh on the north side. This low tract of land, forming a delta, has been produced by the gradual accumulation of detritus brought down by the stream.

The Little Sturgeon, or Silver river, enters the Great North bay with a swift and deep current, being navigable for canoes, without interruption, for a distance of a little over two miles from the lake, where the stream becomes very small and rapids occur. The general course is at first nearly north, and the upper course is nearly northeast, to its sources in the southern part of the township of Blyth. Duchesney and Chippewa creeks enter the lake in the vicinity of North Bay. The Rivière de la Vase, or Little Mattawa, flows into the lake about five miles southeast of North Bay. Other important tributaries enter the lake from the south, but these are beyond the boundaries of the present map. The Veuve river is an important stream which enters the west side of McLeod bay, draining a large tract of land, the sources extending westward almost to the Wanapitei river.

Several important islands and groups of islands occur, lying out towards the middle of the wide eastern portion of the lake. The most important of these is the group named the Manitou islands. These are five in number, situated five miles southwest of North Bay. The largest is known as the Great Manitou or Newman island. It is an irregular triangle in form and about a mile across. McDonald island, the next in size, is about half a mile in length from north to south but only a few chains in width. The other three islands are much smaller.

The Goose islands lie toward the centre of the open part of the lake, about six miles west of the Manitou islands, and about twelve miles west-southwest of North Bay. The largest island is known as the Great Goose, and is nearly a mile long with a trend of east and west. To the west and northwest of these there are about a dozen smaller ones, some of which are merely rounded hummocks of rock.

The general aspect of the western end of Lake Nipissing is rocky and desolate. In many cases the sparse soil overlying the rarely concealed hummocks of rocks affords substance to a rather thin and scrubby growth of red pine, while the level spots are for the most part occupied by vast marshes, but some small tracts of level land occur along the banks of some of the tributaries, notably the one situated on the south side of Bear bay near its entrance. The northern shores of the lake, however, border large areas of cultivable land. The rocks are generally well exposed, especially in the western and southern portions of the lake. They include the prevailing varieties of granitite-gneiss and hornblende-granitite-gneiss, the former being the prevailing type. These are cut by dikes and masses of pegmatite presenting the usual characteristics.

The Manitou islands are composed of a rock which is remarkably uniform in composition and appearance, being a medium-textured reddish gneiss, that has evidently been subjected to intense dynamic action. It has a rather indistinct blotchy appearance, due to irregular bands of chloritic and epidotic material running through it, resulting from the alteration of the bisilicates. The microscope shows that the rock has everywhere been greatly granulated. Its chief constituents are quartz, orthoclase, plagioclase, hornblende and biotite, with epidote, chlorite, calcite, sericite, iron ore and apatite. It is thus a hornblende-granite-gneiss which has suffered great alteration, the feldspar being turbid and [illegible] inclusions of sericite, calcite, &c., resulting from its decompo[illegible] Numerous irregular patches of calcite are scattered through [illegible]on. Both feldspar and quartz extinguish very unevenly. Hornblende is the most abundant ferromagnesian mineral present, but it has suffered such extreme alteration to chlorite and epidote as to mask its true characters. Biotite, largely altered to chlorite, occurs intergrown with the hornblende. The section is traversed by numerous cracks filled in with secondary quartz, epidote, iron oxides, &c.

On several of the islands this rock, which has evidently resulted from the crushing of a hornblende-granite, contains large patches of pinkish crystalline limestone; the latter, however, doubtless represents portions of the clastic Grenville series. The gneissic rocks are intersected by dark-greenish dikes of basic material previously described in that portion of the report treating of Post-Archæan eruptives. On several islands small outliers of the Birds Eye and Black River formations are exposed, as elsewhere noted.

Rock exposures are abundant on the Goose islands, showing a medium-grained red granitic gneiss. The foliation is determined by the parallel arrangement of the little bands of biotite. The principal constituents are quartz, orthoclase, plagioclase, microcline and biotite, with small quantities of apatite, zircon, chlorite, epidote, sphene, calcite and secondary iron ore. It is one of the typical biotite-gneisses or granitite-gneisses of the region, evidently resulting from crushing and differentiation of a granitite. The feldspars are exceedingly turbid, being filled with dust-like particles and contrasting sharply with the clear quartz grains. Orthoclase predominates, but plagioclase (albite) is very abundant. Most of the microcline grains observed exhibit a moiré-structure rather than the typical rectangular lattice structure. The biotite shows alteration to chlorite with development of secondary magnetite along the cleavage-planes. Apatite and zircon are both abundant in large well-formed crystals, as well as irregular grains. Numerous skeleton forms are scattered through the section, filled with calcite and a substance resembling leucoxene. Their outlines, sometimes rudely wedge-shaped, are defined by minute granules of a secondary iron ore, which also run along what were originally cleavage cracks. These in all probability represent titanite originally present in the rock, which has undergone almost complete alteration with formation of calcite and ilmenite. Minute granules of epidote are present as the result of the alteration of the feldspars. The rock does not present evidence of having been subjected to an intense degree of pressure, for although both quartz and feldspar have wavy extinction the quartz grains are only slightly cracked and not granulated to any extent.

STURGEON RIVER.

The Sturgeon river,* one of the largest in the country to the northeast of Lake Huron, possessing a drainage area of about three thousand square miles, takes its rise beyond the region covered by the accompanying map-sheets, and close to the sources of the most easterly branch of the Montreal river. From the source to its mouth on Lake Nipissing the river measures about one hundred and [illegible] miles in length, the general course being to the southeast. At a distance of one hundred and twenty-five miles from the mouth the stream is divided into two branches inconsiderable in size. The [illegible] westerly of these has never been explored, but the branch which comes from the northeast drains an important chain of lakes forming the well-known canoe-route to Shusawagaming† (Smoothwater) lake at the head of the eastern branch of the Montreal river. Three miles below the forks the river expands to a quarter of a mile in width for a mile and a quarter, forming Paul lake,‡ which is frequently though incorrectly described as the source of the Sturgeon. This lake is about 1,258 feet above the sea. The Sturgeon debouches in an extensive marsh by two channels. The most direct or westerly one is almost completely filled with detritus, while the eastern branch is comparatively deep and navigable even for steamers. Once across the bars the river offers uninterrupted navigation as far as the village of Sturgeon Falls, over four miles from the lake.

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*This river is called "Champlain's river" on Delisle's map of New France 1703.

In ascending the stream the general direction is N. 35° E. for eleven miles in a straight line. This is to the mouth of a tributary coming from the east, known as Smoke river, that drains the southern portion of the townships of Grant and Charlton. In this distance navigation is interrupted by two falls and two rapids. The first of these, Sturgeon falls, is opposite the village of the same name, at the intersection with the main line of the Canadian Pacific railway. Sandy falls is the name of the next, nearly six miles above the village, while the rapids, which occur a couple of miles beyond, generally require to be portaged in the ascent, although they can be run in descending. The portage to avoid this half-mile of broken water is on the west side of the stream.

Near the mouth of the Smoke river the Sturgeon takes a sudden bend, and has an upward direction in a straight line of N. 61° E. for twenty-eight miles, as far as the 'Elbow,' in the township of Janes. Following all the sinuosities of the stream, however, this distance is increased to a little over thirty-six miles. The main tributaries in this interval are from the north, draining large lakes in this direction. The Timagami, which is a very turbulent and rapid stream, is the largest feeder of the Sturgeon, and is the principal outlet of the large lake of the same name. It enters the Sturgeon a little over twenty-three miles above the mouth of the Smoke river. The Tomiko (contraction for Otanacomagosi or Canoe-making) river enters a little over five miles above Smoky falls, deriving most of its water from several large lakes situated in the townships of Gladman and Hammell. The lower portion of the stream, from Tomiko lake to the Sturgeon, is rarely if ever used for the purposes of canoeing. A long portage, to avoid this rough stretch of river, runs northward from the Sturgeon, starting from a point nearly two miles above Smoky falls. It affords an entrance to Cameron lake and thence through Chebogomog lake into Tomiko lake. The upper portion of the river, however, is travelled to reach the numerous lakes situated near the headwaters of the several branches of the stream and thence to the region beyond. Pike river is another feeder, coming from a lake of the same name, situated near the centre of the township of Bastedo.

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†Sometimes also called "White Beaver lake" from a mountain of that name which rises immediately to the west of the lake.

‡The name is given in honour of "Big Paul," a sub-chief of the Timagami band of Chippewa Indians, who has made this lake his headquarters for many succeeding winter hunts.

Between the mouth of the Smoke river and the 'Elbow' the Sturgeon is broken by one fall and five rapids, the latter all situated above the mouth of the Timagami river. The most important of these obstructions is the Smoky falls, where the river descends over a solid barrier of gneiss for more than twenty feet. The portage runs over a small rocky island of gneiss which here divides the river into two channels.

At the 'Elbow' the trend of the river again changes abruptly to a direction of N. 14° W., which course is maintained as far the mouth of the Obabika river, a distance of twenty-two miles increased to thirty-four miles by the bends of the stream. Only a little over a third of this distance is included on the accompanying maps, as far as the mouth of the outlet from Wawiashkashing and Manito-peepagee lakes. The largest tributary in this distance is the Maskinongé river, that reaches the main stream from the west about two and a half miles above the 'Elbow' and drains a number of large lakes, shown on the Sudbury map-sheet (No. 130.)

The Sturgeon river is in general readily navigable for canoes throughout the whole distance embraced in the present map-sheets, although the current is strong nearly the whole way. Between Smoky falls and a point about three miles above the mouth of the Timagami branch (a distance of about twenty-five miles) there is no greater impediment to canoe navigation than the strength of the current. The river, except where contracted at the rapids and falls, varies in width from a little over two hundred and fifty feet near the mouth to about a hundred feet in the township of McNish near the northwest corner of the Lake Nipissing sheet. The depth varies from three to twenty feet, with an average of perhaps ten or twelve feet.

The flats along the river are liable to inundation during the high spring freshets and the actual rise in the water at the several points along the course of the stream may be readily ascertained by a reference to the appended list of elevations.

The river for the most part pursues a somewhat tortuous course through a tolerably level flat of considerable extent, exhibiting numerous sections of a stiff greyish clay overlain by coarse yellowish sand, in the immediate valley of the Sturgeon. Below the Timagami river there are many areas of considerable extent which have been utilized for the settlement and the soil has in general proved productive. Between the mouths of the Timagami and Maskinongé rivers these flats are fewer and less extensive while the country immediately adjoining becomes for the greater part poor and rocky. Above the Maskinongé very little land is available for farming, the country assuming a broken and mountainous character.

The rocks throughout this distance present the usual characteristics of the reddish and dark-greyish gneisses. The dip is towards the south or southeast at an angle of often considerably less than 45°. The exposures in the immediate vicinity are very few, and except in the neighbourhood of falls and rapids are small, consisting chiefly of rounded hummocks protruding from the overlying drift material.

The contact between these rocks and those of the Huronian, occurring to the northeast, crosses the Sturgeon river a short distance above the 'Elbow.' The actual junction is not visible, but exposures of the flesh-red granite-gneiss of the Laurentian and the light greenish compact quartzite of the Huronian occur within a short distance of one another.

THE MONTREAL RIVER.

The Montreal river is, next to the Ottawa and Sturgeon rivers, the largest stream included within the area covered by the present report, draining an area of about 2,500 square miles.

The general course of the river, so far as it is included in the Lake Timiskaming sheet, is southeast, and the length almost forty-seven miles in a straight line. This may be divided into three parts, the first and third of which are approximately parallel in direction, while the second, or short intervening stretch, lies almost at right angles.

The lower portion of the river, from Lake Timiskaming to Mud Lake portage, is now superseded as a canoe-route by the shorter and easier passage by way of Haileybury, Mud and Sharp lakes. There are numerous rapids, and the river, throughout this distance, flows in a narrow valley, generally from 400 to 450 feet deep. Only a few small streams enter this portion of the river, as the highest land occurs in close proximity to the banks on either side. The lowest three miles of the river, before it reaches Lake Timiskaming, are a series of rapids with a fall of 160 feet. At the 'Notch,' near the mouth, the river flows through an extremely narrow channel, with

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See Plate IV.

rocky perpendicular walls, composed of dark-greenish greywacké slate, much jointed and broken. This gorge has a breadth varying from sixteen to thirty-three feet and is a little more than a hundred yards long, with perpendicular walls about forty feet high. The rapids above referred to are overcome by a portage about three miles long.

For about six miles above this portage the river is crooked, with a fairly gentle and uniform current, its channel being cut through a narrow plain of stratified drift material. There are only occasional outcrops of rock, and these show a comparatively fine-grained arkose, forming the transitional beds upward, from the greywacké and slate to the quartzite grit that characterizes the summits of the hills extending westward to Bear lake.

Three rapids occur in the next stretch before Fountain fall is reached, the total fall in this part of the river being over thirty feet. The rock, wherever exposed, is a dark-green somewhat coarse diabase or gabbro, the feldspar, especially in the coarse phase, being frequently of a reddish colour. Fountain fall has a sheer descent of twenty feet over an outcrop of breccia-conglomerate. Ragged chute is situated a short distance above, and has a fall of about thirty feet. The hills on either side of this wild rapid rise precipitously from the river, and the portage, which is situated on the northeast bank, runs over a very high and steep hill. The rock exposed is the usual breccia-conglomerate, showing a dark-green chloritic matrix which is often present in comparatively small proportion, in which is embedded an abundance of fragments of feldspar, granite and diabase. About a mile above Ragged chute the slate is superimposed upon the conglomerate, dipping S. 70° N. < 20°. Two more rapids of considerable dimensions occur in the spaces between Ragged and Hound chutes, having a combined fall of thirteen feet. At the latter place the waters of the river make a clear leap of twenty-five feet, over an outcropping ledge of diabase. From the head of Hound chute to Mud Lake portage the banks on either side of the stream, and especially those on the northeastern side, exhibit perpendicular cliffs composed of diabase, greatly resembling and co-extensive with a large mass which reaches the west side of Lake Timiskaming, there forming the cliffs known as the Manitou and Devils Rock. The current in this interval of nearly five miles is very swift, showing a total fall of about eight feet, but with no distinct rapids.

Immediately below Mud Lake portage is a high hill of diabase that rises precipitously from the water on the northeast side, while a short distance above, on the opposite side, smaller elevations composed of similar rock were noticed in close proximity to the stream. In the vicinity of the first rapid above Mud Lake portage the banks are again high and rocky, composed of the coarse diabase or gabbro, with much flesh-red feldspar, giving it somewhat the appearance of a basic granite. A small rocky island about twelve chains below the rapid shows this diabase to possess a very perfect series of jointing planes with a direction of N. 50° E. and dipping S. E. < 70°. The strike of these planes corresponds closely with the trend of the stream at this point and may have been the cause of its direction. The rapids, which are very strong, have a fall of seven feet, and are caused by a barrier composed of outcroping ledges of the diabase aided by an accumulation of loose boulder material. There are no exposures of rock between the head of these rapids and Bay lake, while the river, between the two other intervening rapids, is marked by the occurrence of comparatively wide lake-like expansions, which in places show a considerable current.

Bay lake, known to the Indians as Paksegama or Mattagamashing, occupies a rather deep depression in the rocky plateau, being bounded, especially on the southwest side, by high rounded hills of slate and quartzite. It runs in a northwest and southeast direction, with a length of seven miles and an average breadth of a little over a quarter of a mile. A large bay near the northwestern extremity runs in an easterly direction for about two miles and a half. The portage from Loon lake, on the road to Timiskaming, reaches the northeast corner of this bay, while the Hudson's Bay Company's post is situated on the point on the northwest shore of the lake near the entrance to Portage bay.

The southwestern shore, near the southwestern end of Bay lake, shows excellent exposures of well banded and evenly jointed greenish-grey slates, while the northeastern shore in this direction is low and covered with thick green bush. About a mile and a quarter north of the outlet the slates are overlain in comformable sequence by the yellowish-green quartzite-grit, the whole having a northwesterly dip < 5° to 12°. The slate as usual shows a gradual transition through a more massive slate into a greywacké or feldspathic sandstone, which merges upward into the comparatively coarse-grained arkose sandstone or quartzite-grit that rises into hills varying from 250 to 300 feet above the lake, in places forming precipitous cliffs of considerable height.

A specimen of this rock was examined by the late Prof. G. H. Williams and was taken to represent the transitional portion near the immediate junction between the coarse greywacké and the quartzite or arkose. The small hand specimens showed a banded coarse and fine conglomeratic sandstone or greywacké. The coarser portion of the specimen presents the ordinary characters of the prevailing quartzite-grit, holding good sized fragments of quartz both angular and rounded in outline, embedded in a moderately abundant sericitic matrix. The finer-grained portion, which has a somewhat darker hue, is a rather typical greywacké, showing 'an aggregate of angular and subangular quartz grains with some feldspar. Between these grains much chloride has been developed, which, together with the magnetite present, gives the dark colour to this layer.'

This quartzite, as usual, occurs in very thick and massive beds and the dip cannot be made out with any certainty except in a few places. It is exposed all along the southwest shore of the lake as far as the inlet and forms the southwestern portion of the point that separates Portage bay from the main body of the lake. Farther up the river the rock is underlain, first, by a massive brownish greywacké or slate, exposed a short distance below Pork rapid, and next, in descending order, by the well banded greenish slates, dipping S. 55° E. < 10° to 15°, which continue as far as and a little beyond the inlet from Lady Evelyn lake. The structure is, therefore, that of a somewhat shallow syncline, the basal bed being represented both by the banded slates exposed in the southeastern part of Bay lake and those occurring in the vicinity of the outlet from Lady Evelyn lake, the overlying quartzites resting in the trough thus formed.

The point on which Bay Lake post is situated is composed of coarsely crystalline diabase or gabbro, the feldspar frequently possessing a distinct flesh-red colour. The massive and rounded exposures of this rock are cut by irregular ramifying dikes, composed of a fine-grained pale-greyish or pinkish aplite. This basic irruptive forms the shores of Portage bay, as well as the northeastern part of the point separating this bay from the main body of the lake. To the northwest of the lake it continues for a considerable distance inland, forming a series of high, though rounded, hills in this district, while to the east, as far as can be learned from the occasional outcrops, it is continuous with the mass which forms the southern part of Sharp lake, extending as far as the western shore of Lake Timiskaming.

Between the head of Bay lake and the head of Lady Evelyn lake, (Mattawapika), the river is in general a fine, wide stream, with occasional short stretches of swift current. Pork rapid, (Kokooshbuwatik), has a total fall of nearly seven feet, the portage being on the southwest bank. The northeastern banks of the river are low, and the country for many miles is flat and swampy. On the southeast side in that direction there are only occasional low rounded exposures of the greywacké and slate, and these are situated some distance away from the stream, forming a series of rounded hills. Between the

Mattawapika and Round or Mountain lake the river is, as a rule, wide and navigable, with only two interruptions by rapids. One of these is a little over a mile and the other about four miles below Round lake, the portage in both cases being on the northern or northeastern bank of the river. The combined fall of these two rapids is about eight feet, the upper one being the larger with a descent of five feet.

The shores in the vicinity of the Mattawapika show exposures of a well banded slate which dips S. 55° E. < 10° to 15°, and continues for about a mile above this point, where it is interrupted by a mass of diabase or gabbro, which, on the southeast side, rises into a series of precipitous hills. This rock may extend across the stream to the northward, but any hills on this side are much lower and less pronounced, and are, therefore, more likely to be underlain by the greywacké slate. This mass of diabase extends to within a quarter of a mile of the outlet from Moccassin lake, and is an extension northward of the mass of similar rock which forms the western shore of the last stretch of Lady Evelyn lake. To the northwest this diabase is replaced by the quartzite grit or arkose which forms smaller and less conspicuous eminences extending northward and inland for some miles; while to the northeast the general surface outline would seem to indicate its continuous presence as far as the southeastern extremity of Indian lake, although no exposures could be seen. The rock is the usual greenish or reddish-grey, coarse arkose, so prevalent throughout this district. A specimen of this rock was examined by the late Prof. G. H. Williams, who says that 'it shows an even-grained mixture of somewhat rounded quartz grains with an equal amount of feldspar (orthoclase, microcline and oligoclase). The minerals and their proportions are those of a granite, and yet the appearance of the grains and their relations to one another at once disclose the clastic character of the rock. The feldspar, except a few of the largest grains, is quite changed to kaolin or sericite, although its external characters are still plainly discernible.'

Indian lake [illegible] an irregular expansion of the river crossing its downward course [illegible] a considerable angle, and discharging from the southwest side nearly a mile from the foot of the lake. Near Indian lake the banks are somewhat higher and are composed of greyish stratified clay, which makes a good soil. The shores of Indian lake are as a rule low and grassy, presenting no rock exposures, but the comparatively high hills that border the southwestern end of the lake are probably composed of quartzite-grit. From Indian lake to Round or Mountain lake the river flows with a very gentle current between banks of moderate height composed of stratified grey clay. As the first rapid is approached these banks are appreciably higher, but above the second rapid the area on either side of the river becomes much lower, while the immediate outlet from Round lake is flat and swampy. Both of the rapids below Round lake are caused by boulder obstruction. The southwestern shore of Round lake shows high hills composed of the coarse diabase or gabbro, and exposures of this rock were noticed on the northeastern side near the outlet, but to the northeastward of the lake the whole region seems to be comparatively level, the soil being a clay loam. The diabase and gabbro contain much flesh-red feldspar, greatly resembling in this respect the coarser portions of the rock exposed at Quinn point on Lake Timiskaming as well as on the northeast shore of Bay lake. When subjected to the weather this feldspar kaolinizes, thus producing a moderately coarse-grained rock, closely resembling in macroscopic appearance a basic hornblendic granite.

THE MATABITCHOUAN RIVER.

The Matabitchouan and Montreal rivers reach Lake Timiskaming almost at the same point, but while the general course of the latter is from the northwest, that of the Matabitchouan is from the southwest. The proximity of the mouths of these two streams has, in the past, been the cause of some little confusion in the names applied to each. Matabitchouan seems to have been the original Indian name of the Montreal river, while what has of late years been called the Matabitchouan is known to the Indians as the Wabos-na-ma-ta-bi-sipi (or Rabbit-sitting-down river). The names have now, however, become fixed as here employed. The Matabitchouan is one of the most important streams in this district, and for many years was the only canoe-route in common use between Lakes Timiskaming and Timagami. Its headwaters lie to the north and west of White-bear lake. The smallest branch takes its rise in Caribou lake, on the main canoe-route, within a quarter of a mile of the northeast arm of Lake Timagami, and this small lake sends another and larger stream into Lake Timagami. The largest or main branch of the river rises in Mountain lake, to the southeast of Annima-Nipissing and Bay lakes. Two other branches of some size drain lakes that lie close to the hills bordering the lower stretch of the Montreal river, debouching in the northeastern corner of White-bear lake within a short distance of one another.

From the mouth on Lake Timiskaming to Mountain lake, the distance, in a straight line bearing N. 70° W., is nineteen miles, while following the general canoe-channel this distance is increased to thirty-seven miles. This whole space is divided into two main directions of flow, forming an angle of 70° with one another, these constituting two sides of a triangle, while the third has the length and direction already mentioned. The first of these stretches, which extends from the south of the river to Rabbit lake, has an upward bearing of S. 44° W. for thirteen and a half miles, although the channel usually travelled measures about sixteen miles. The third side of the triangle, which reaches from Rabbit point to Mountain lake, shows a general direction of N. 26° W., with a length of nineteen miles, although the most direct canoe-channel measures about twenty-one miles. From the mouth of the Matabitchouan to the first portage the river has cut a fairly deep channel through drift material, the banks on either side being composed of a stratified grey clay. The strength of the current in this interval varies with the height of the water, for during times of freshet the water of the lake backs up, forming a comparatively deep channel to within a short distance of the first portage; while, during ordinary stages, the stream has a swift current almost to the mouth. The northern banks are as a rule much lower than those on the south side of the stream. A short distance south of the river is a high and prominent hill, known as the King of the Beavers, also sometimes called the Montreal mountain or Beaver mountain. According to barometrical observations this hill has an elevation of 660 feet above Lake Timiskaming, or 1,248 feet above the sea.

The summit of Beaver mountain, for 340 feet, is composed of a greenish-grey medium textured diabase, much sheared and broken, the planes of shearing abundantly coated with greenish decomposition products. Below this rock is a greenish slate, which marks the lower and more gradually sloping portion of the mountain. The strike of the slates curves around, conforming beautifully with the line of outcrop of the diabase, dipping into or beneath what seems to be an irruptive mass of laccolithic origin.

The first, or Matabitchouan portage, occurs a little over two miles from the mouth of the river, where a series of rapids and falls occur with a descent of 260 feet. The stream here describes a sharp bend to the north, while the portage to overcome these obstructions cuts across the bend thus formed, running over a hill, the highest point on the trail being 330 feet above the level of the river at the foot of the portage. The ascent of the portage is steep, passing first over stratified grey clay, and clay and boulders, but near the summit it is rocky. This is the breccia conglomerate, containing pebbles chiefly of a flesh-red granite embedded in a dark-green chloritic matrix. The west end of the Matabitchouan portage comes out on the first of a series of four Bass lakes, numbered in ascending order. These are small expansions, united by narrow shallow channels, with an appreciable current.

The southeast shore of the Second Bass lake consists of high perpendicular cliffs composed of a fine-grained hornblende-granite, evidently an extension of the large mass of somewhat similar rocks coloured as Laurentian farther to the south. At the base of the cliff, near the upper end of the lake, this granite may be seen in contact with the breccia-conglomerate that constitutes the basal member of the Huronian. Precisely similar rock forms the eastern shore of the Third Bass lake, but is so massive that no lines indicating original sedimentation could be discerned. A thin section of the finer portion, or matrix, of this conglomerate, obtained from an exposure immediately below the rapid that separates this lake from the next succeeding one above, shows the rock to be a highly feldspathic sandstone or greywacké, consisting of subangular grains of quartz, orthoclase and plagioclase with a considerable amount of a green chloritic decomposition product occurring for the most part between the quartz and feldspar grains and giving the rock its general greenish tint. A few grains of pyrite are also present. The majority of the grains are composed of feldspar, which is a good deal decomposed, while the quartz shows evidence of having been subjected to great pressure. On the western shore of the lake, near the upper or south end, exposures of greenish banded slates may be observed, dipping to the westward at a low angle and overlying the breccia-conglomerate of the eastern shore. These slates constitute a belt about a quarter of a mile in width, and to the west merge gradually upward through a massive and uniformly fine-grained greywacké into the sea-green sandstone or quartzite-grit that forms most of the shores of Trout lake, (a small expanse of water to the northwest of Third and Fourth Bass lakes).

A rapid with a considerable fall intervenes between the two upper Bass lakes. Macdonald creek, an important tributary, enters the Fourth Bass lake from the south, draining a number of lakes in that direction. On the west shore of the bay into which this creek empties are high rounded exposures of the breccia-conglomerate, while at the small rapids at the upper or southwest end of the lake are ledges of the overlying greenish banded slates, striking about northeast and dipping to the northwest.

Above the Fourth Bass lake a small rapid occurs, and a short distance beyond five rapids follow in quick succession. During times of low water a portage known as the Kanebeatika (or Along-the-rocks) portage is made on the south side of the river, commencing at the foot of a small fall and running for a distance of nearly three-quarters of a mile. Frequently, however, the passage either up or down is made by keeping close to the stream and utilizing the shorter trails. The north side of the river shows precipitous cliffs of greenish banded slates, which rise abruptly from the water's edge to a height of over a hundred feet, having at the base a talus of angular blocks. Only a quarter of a mile separates these from the Devils rapid, where the water pours through a narrow cañon of slate, with a portage on the south side of the stream. The banded slates here exposed have a strike of N. 20° E., with a dip to the northwest. A quiet stretch of similar length separates this from the next succeeding rapid, at the foot of which the green banded slates strike N. 64° E. and dip northerly < 50°. The upper end of this portage shows exposures of a somewhat coarse gabbro or diabase, a belt of this rock about three-eighths of a mile wide crossing the river at this point and interrupting the slates and greywackés. A stretch of three-quarters of a mile of comparatively deep and navigable water, with swift current at only one point, occurs in the interval before the foot of the next portage, which is the last before Rabbit lake is reached. This portage, which is a little over a half mile in length, passes two rapids and a chute, the latter exhibiting a very pretty fall of about fifteen feet at the immediate outlet of the lake. A specimen obtained at the foot of the portage is a very fine-grained reddish-grey rock, resembling a felsite macroscopically.

At the outlet the rock is a fine-grained greenish-grey felsite or feldspathic sandstone very similar to the last in composition with a strike N. 60° E. and a dip to the northwest< 50 °. It is impossible, however, to be sure that these planes represent original lines of sedimentation, for a little over a mile to the south of Rabbit chute, on the west side of Outlet bay, the greenish banded slates were seen dipping about west< 50° and superimposed upon the breccia-conglomerate which forms the eastern shore of this bay wherever the rock is seen.

The present name, Rabbit lake, by which this stretch of water at the head of Rabbit chute is known, is an abbreviated translation of the Indian designation Wabos-na-ma-ta-bi (or Rabbit-sitting-down lake) because of the occurrence at one of the most prominent points of a large angular mass of greywacké which has a fancied resemblance to a rabbit in a sitting posture.

The lake has a general trend of northwest and southeast, and the distance from Rabbit chute to the end of Southwest bay is ten miles in a direct line, although the distance from portage to portage on the canoe-route is a little over eleven miles. The average width of the lake is about three-eighths of a mile, while its total area is about eight square miles, and its height about 939 feet above sea-level. The lake has a rather irregular outline, with a number of large bays, which are, in their turn, cut up into many smaller inlets. At the southern end of Outlet bay one of these indentations stretches away to the southeast, crossing the strike of the rocks for a distance of over two miles. During extreme high-water a small stream flows out of the end of this bay into Ross lake, at the headwaters of Macdonald creek, which flows into the Matabitchouan river at the Fourth Bass lake. The bay running to the northwest forms a portion of the main route of travel between Timiskaming and Timigami lakes. With a gradual curve from the north to the northwest it reaches the foot of the portage to White-bear lake, about five miles from Rabbit point. The Southwest bay is really a continuation in this direction of the main body of the lake.

Near the southern end of Outlet bay a mass of greenstone (diabase and gabbro) crosses Southeast bay, and, running parallel to Outlet bay, but a short distance inland, this doubtless connects with the belt of such rocks that crosses the Matabitchouan at the third rapid below Rabbit chute. This band is a little over half a mile in width, and in the vicinity of Outlet bay is followed by the massive breccia-conglomerate, which is in turn overlain by the fine-grained brownish, and greenish-grey slaty rocks with a strike of N. 5° W. and a dip west < 20°. This diabase, as it may be named, is by no means homogeneous in composition, and patches of granitic aspect and composition occur without any sharp line of division, merging by degrees into the more basic portion of the mass. In places these granitic patches are cut by dikes of fine-grained diabase evidently of somewhat later origin.

To the south of this greenstone mass a belt of the breccia-conglomerate comes in, but the actual contact is hidden in a low valley at the foot of a small bay on the southwest shore. On the southwest side of the bay the conglomerate band has a width of a quarter of a mile, but on the northeastern shore it is somewhat wider. The matrix is a fine-grained, compact, dark greenish-grey rock, breaking with a conchoidal fracture. Under the microscope it is seen to consist of a very fine-grained mosaic of quartz and feldspar, filled in with minute scales of chlorite and sericite and granules of epidote. In this are scattered larger fragments of quartz, orthoclase, plagioclase, microcline, hornblende, biotite (both the latter minerals largely altered to chlorite) and sphene. In this fine-grained portion are embedded occasional pebbles and fragments often of considerable size, composed chiefly of red and grey granite. Near the contact with the granite rocks to the south the rock is seen to have undergone extensive d formation by pressure, the resulting shearing-planes being abundantly coated with the usual greenish products of decomposition. The pebbles themselves, which are relatively much more abundant, are seen to have been stretched and rolled out as a result of such extreme dynamic action; while a very marked foliation has been developed in the finer-grained portion of the rock, which is seen to wrap around and conform as closely as possible to the outline of each individual fragment.

Besides these lengthened pebbles there are granitic inclusions, running for the most part with the cleavage, but which in most cases present a somewhat more irregular and indistinct outline. These appear to be of the nature of small apophyses of granite, although it is exceedingly difficult to discriminate in ev [illegible] between these irruptive dike-like intrustions and the distin [illegible] fragments which have been considerably flattened as a result [illegible] re. The cleavage or foliation of this conglomerate has a direction varying from S. 18° W. to S. 21° W., with a prevailing southeasterly dip at a high angle.

The junction between this rock and the granites and gneisses exposed to the south was seen crossing the lake about three-quarters of a mile from the foot of Southeast bay. The line of outcrop of the granitite-gneiss seems to form a considerable angle with the planes of foliation of the conglomerate, intersecting these in a direction of S. 53° W. Farther to the south the granitite-gneiss is considerably mixed with a much more basic rock, doubtless either a gabbro or a gabbro-diorite, which, however, appears to have been an integral portion of the same magma from which the granitite-gneiss has solidified. The gneiss is, as a rule, very granitoid in aspect, sometimes very coarse-grained and even porphyritic in structure, while in other places not far distant it is of medium texture and distinctly foliated, this structure being determined by the alternation of reddish and greenish-yellow bands. The strike of this foliation varies from N. 23° E. to N. 33° E., while the dip is to the northwest $<45°$ to 50°. Under the microscope a precisely similar rock from the Southwest bay is seen to be a granitite-gneiss, composed of orthoclase, plagioclase, quartz, chlorite(derived from biotite originally present) and epidote, with small quantities of sphene, apatite, and secondary calcite. The alternation of reddish and greenish-yellow bands so characteristic of this rock is due to the parallel disposition of certain layers of feldspar stained by iron oxide, with others in which the feldspars present have undergone extensive saussuritization; the resulting scales and granules of sericite and epidote arranging themselves in a more or less definite position at right angles to the direction of pressure. This granitite-gneiss and associated granitite, with a much smaller proportion of 'greenstone,' occupy all of the southern end of Southeast bay, and are continuous with the large mass of essentially similar Laurention rocks exposed in the region to the south.

The contact between the granitite-gneiss and the slate-conglomerate is very evidently of an irruptive character. The slate-conglomerate is everywhere, near the line of contact, much squeezed, and is in places penetrated by small dikes of the irruptive rocks ; while fragments of the former may be seen caught up and embedded in the gneissic-granite, even at a considerable distance from the line of junction, on both sides of the bay. Near the line, the matrix of the conglomerate is much hardened as a result of such igneous action, or rendered much more chloritic and epidotic as a result of the presence and percolation of heated waters. On the northeast shore, near the contact between the two rocks, the foliation of the granitite-gneiss dips to the northwest< 30°, while the conglomerate has an almost if not quite vertical attitude; although farther to the north it dips to the northwest< 50°.

The southern shore of the main body of Rabbit lake is composed of a very distinctly and evenly bedded slaty graywacké, of grey and greenish-grey colours, the greenish colours being due to the relatively greater abundance of sericite and chlorite. The strike varies from N. 18° E., on the shore opposite Rabbit point, to N. 40° E. near the northeastern part of the stretch, curving gently with the trend of the shore. The banks rise rather abruptly from the water's edge, in places forming low vertical cliffs of slate, especially near the northeastern portion. The effects of glaciation are very marked. The graywacké-slate rests conformably upon the breccia-conglomerate which forms the northeastern shore of this portion of the lake wherever any outcrops of rock occur, the bank shelving gently, as a rule, towards the lake with a gravel or shingle beach along the water's margin.

To the southwest the breccia-conglomerate extends to Rabbit point as well as along the east shore of Northwest bay for some distance north of Rabbit point. The various exposures of this conglomerate show no special features worthy of mention in this place.

Rabbit point is a narrow projection that extends into the lake from the north side of the junction between the main lake and Northwest bay, a little over six miles from Rabbit chute. The rock composing it is the prevailing breccia-conglomerate, but, as in most cases, it is exceedingly difficult if not impossible to determine any line of stratification, and the cleavage or foliation, which is the most obvious and only distinct structural feature present, has a strike of N. 15° E., and a dip S. 75° E. < 80°.

There are two small islands about the centre of the lake a short distance to the west and northwest of Rabbit point. The larger and more northerly of these is composed of dark greenish-grey breccia-conglomerate, the matrix of which has a distinct slaty cleavage. The pebbles and boulders are composed chiefly of red and grey granite, and sometimes of reddish-grey gneiss. The inclusions vary in size from the smallest pebbles to boulders two feet and over in diameter. Besides these composite fragments there are a great many angular pieces of feldspar, which, where they are abundant, give the rock a pseudo-porphyritic appearance. Most of the fragments are composed of a deep flesh-red granite, showing a preponderance of red feldspar with a less quantity of grey translucent quartz, and a trifling amount of green chlorite resulting from the decomposition of biotite. Next in abundance is a reddish-grey granite somewhat more basic in composition than the last, while in certain instances occasional rounded fragments of a distinctly foliated reddish-grey gneiss were noticed. Besides these there are fragments that seem to be referrable to some of the finer and more compact slaty greywackés of the Huronian.

In addition to this distinctly clastic material some granite inclusions were seen with an irregular though lenticular outline, pegmatitic in structure and origin. Such patches or areas were sometimes six and even eight feet in length, which coincides with the direction of the foliation of the enclosing rock. The strike of the foliation, which is distinct, is N. 6° E., with an almost vertical attitude. The smallest of these islands is composed of a very similar rock, but more massive in structure. Around the included masses, especially the larger ones of granite, the rock has an apparent flow-structure, with lines conforming as closely as possible with the outline of the included fragments. The whole rock-mass has very evidently been subjected to intense pressure, which has completely destroyed any bedded structure which may have originally existed and replaced it by a more or less perfect jointed structure.

Opposite these islands, and forming the eastern shore of the lake, is the same greenish-grey breccia-conglomerate, with a foliation striking N. 8° E., and a dip to the east varying from 60° to nearly vertical. To the south, as the mass of diabase or gabbro is approached, the breccia becomes much more contorted and broken up. The included fragments are flattened and rendered irregular in outline, and the whole mass exhibits abundant signs of pressure and alteration.

At the immediate contact the conglomeration does not contain many fragments, and the finer slaty matrix is sometimes alone represented; but a short distance away the fragments are so abundant that there is very little of the finer interstitial material. The junction between the two rocks is situated a little over a mile and a half south of Rabbit point. It is very sharply defined and the slaty rock along the line of demarcation is much broken up and jointed, although the cleavage planes conform in a rude way with the line of outcrop of the greenstone. The slate is likewise much hardened, as a result of the intrusion, and breaks with a splintery fracture. The greenstone, which is essentially similar to most of these basic masses, is doubtless a diabase, possessing a dark greenish-grey colour and of medium texture. In places it has a decided reddish tinge, owing to the feldspar being stained with hydrous oxide of iron. This greenstone contains a considerable body of chloritic and epidotic schist, which may have resulted from the shearing of a portion of the eruptive itself, or may represent an extremely altered form of the finer matter of the breccia-conglomerate caught up and embedded in it.

Towards the end of the outcrop, which altogether occupies scarcely a quarter of a mile of shore-line, the rock is of a prevailing grey colour, and much coarser and gabbro-like in structure. Southwards it gives place, at the end of a small bay, to a greenish-grey feldspathic quartzite associated with some very vitreous flesh-red quartzite. In general, near the contact, these rocks have a north and south trend, but about an eighth of a mile to the southeast the greenish-grey greywacké was seen apparently striking N. 23° W. and dipping northeasterly< 60°, but it is improbable that the planes represent true bedding.

The mass of greenstone described above seems to be closely connected genetically with the large mass of granite and similar basic rock, portions of the former occasionally being exposed along the southern and western shores of Reuben lake to the west. By far the greater portion, however, of the shores of Reuben lake, show outcrops of the breccia-conglomerate, full of granitic and other inclusions and fragments, and much hardened and altered. It seems probable that not only is the large mass of granitic and other eruptive rock in close proximity to the west, but also that at no very great depth beneath similar rocks prevail. The southern and eastern shores of the southwestern extremity of Southwest bay are composed of the breccia-conglomerate with a decided slaty or schistose structure. On the south shore the direction of foliation varies from S. 28° W. to S. 38° W. and the dip southeast< 65° to 70°. The rock, although of a prevailing light greenish-grey colour, frequently presents pearly-green cleavage-planes, due to the development of sericite. In this schistose matrix are embedded pebbles and fragments composed chiefly of the red granite.

Two streams enter the small bay forming the southwestern end of Southwest bay. Both of these small streams come from the west, the more northerly, forming the outlet of Reuben lake, flows down steeply over angular and detached blocks of slate. The other larger and more important stream comes in about an eighth of a mile from the foot and drains many small lakes situated to the west and northwest.

The northwestern and western shores of this small bay are occupied by the greenish-grey slaty greywacké and breccia-conglomerate, and at one place near the stream from Reuben lake massive and jointed slaty feldspathic sandstone forms high perpendicular cliffs. These rocks extend for a little over a quarter of a mile along the shore from the mouth of this stream, where they are interrupted by an irruptive mass composed of a greenish-yellow and flesh-red granite-gneiss in alternating layers. Near the contact the granitic inclusions in the breccia-conglomerate become more irregular in outline, and many of them evidently represent dike-like apophyses of an originally plastic mass which have been injected through the various cracks and fissures in the slaty rock.

This gneiss is of medium texture, and the foliation, which is very distinct, is caused by the parallel arrangement of flesh-red and greenish-yellow bands in alternating sequence. The microscope shows the rock to be composed chiefly of orthoclase, plagioclase, quartz, chlorite, (representing the biotite originally present) and epidote with smaller quantities of sphene, apatite and secondary calcite. In this gneiss the reddish bands owe their colour to the predominance of feldspar stained by iron-oxide, while the yellowish-green portions represent bands in which the feldspar has undergone extensive saussuritization. The strike of the foliation is S. 58° W. and the dip N. 32° W. < 70.

The gneiss occupies the shore southward as far as the stream which comes from the west, a distance of a little over an eighth of a mile. It evidently represents an extension of the much larger mass of similar rocks exposed in the region to the south and southwest. A mass of the slate-conglomerate was seen included in this gneissic rock with granitic intrusions of irregular outline traversing it in various directions. This mass does not extend farther, for the eastern shore shows continuous exposures of a very fissile and altered greywacké-slate. This slaty rock was noticed in several places to contain fragments of granite and feldspar, while at other places they are rare. The rock has evidently been subjected to somewhat extensive alteration and deformation, the exposed edges showing the characteristic wrinkled surface of slaty rocks which have been exposed to great pressure. The strike of the foliation varies from N. 20° E. near the foot of the bay to N. 30° E., near the northeast end. The western shore, south of the mouth of the small stream near the end of the bay, is likewise composed of similar slaty rocks, which vary in strike from N. 3° E. to N. 13° E. These evidently belong to a wedge-like strip, which, inland, quickly ends, and to the southwest is represented only by a number of detached masses caught up and embedded in the granitoid gneiss exposed on the southeastern shores of Rankin and Miller lakes.

The western shore of the Northwest bay of Rabbit lake is composed of the prevailing breccia-conglomerate, but generally so massive that no distinct stratification can be made out, although usually the rock seems to strike with the trend of the shore and dip towards the lake. At one place it forms a cliff named Echo Bluff, over a hundred and fifty feet in height. A little over a mile and a half north of Rabbit point this slaty rock is replaced by a greenish-grey diabase which occupies the shore as far as the first narrows, nearly two miles farther to the northwest. Towards each side of the mass the texture of the diabase is rather fine-grained, but near the centre it is much coarser and granitoid in structure, and as a great deal of the feldspar assumes a flesh-red tint the rock bears a marked macroscopic resemblance to a basic hornblendic granite. In general, however, the rock is medium-grained and diabasic in structure and composition. This basic eruptive extends across the lake to the northeast shore where it forms a small patch, the strike of the neighbouring slate rocks curving around its line of outcrop. A large patch of the greenish-banded slates was noticed caught up in this mass of greenstone still preserving its bedded structure, with a dip of N. 65° W.< 45 North of Rabbit point, on the east shore of Northwest bay, the breccia-conglomerate merges gradually upward into a fine-grained greenish-grey feldspathic sandstone, interlaminated with much fine-grained and darker coloured, banded greenish slates, the cleavage striking N. 4° E., with easterly dip< 80°. The dip of the bedding seems to be to the northeast at a comparatively low angle. This compact greenish grey fine-grained greywacké was examined under the microscope, and found to consist chiefly of irregular and subangular fragments of quartz, orthoclase and plagioclase embedded in a matrix composed chiefly of chlorite and sericite, which give the prevailing greenish tint to the rock. The other minerals noticed were zircon, sphene, ilmenite accompanied by leucoxene, tourmaline and large grains of apatite and epidote. These minerals have evidently suffered but little abrasion through the action of water.

To the north of the small area of greenstone exposed on the northeast side of this bay the shore is occupied by greenish slates, banded by the alternation of dark-green and purplish layers which merge into one another. These slates have a strike of S. 42° E., and a dip to the northeast < 40°. The thin section shows the character and composition of these bands very clearly. Some of the lighter ones exhibit an augen structure, the lenticules being composed of small angular fragments of quartz, with a lesser proportion of feldspar. Surrounding and curving around them are the darker-coloured bands which derive their colour from the relatively greater abundance of small opaque fragments of magnetite. The rock in general may be said to be composed of a fine-grained groundmass of feldspar, which is now greatly decomposed into sericite, occurring in the form of minute light-yellow-green scales, chlorite and granules of epidote. Irregular areas composed of aggregates of chlorite scales, together with small grains of magnetite, are scattered throughout the section.

At the first narrows, about three miles and a half north of Rabbit point, beautifully banded slates of a prevailing pale greenish-grey colour occur. The colour striping is produced by the occurrence of darker and almost black folia lines, which doubtless represent a relatively greater abundance, in these portions of the rock, of grains and dust-like particles of magnetite; while the lighter-coloured bands, originally highly feldspathic, contain a considerable quantity of yellowish-green sericite in minute scales and flakes, developed at the expense of the feldspar, together with a little chlorite derived from the alternation of the bisilicate material originally present in the rock. The outcrop is not far removed from the greenstone mass exposed on the opposite or southwest shore, and seems to have undergone considerable disturbance as well as alteration at the time of the intrusion of the greenstone, the slate dipping to the northwest < 30°.

Beyond this the lake narrows and for about three-quarters of a mile has the character of a stream, including a small rapid. A little above it widens out again into a small lake-like basin, the southwestern shores of which are composed of the massive greenstone.

The portage into White-bear lake begins at the northwestern end of this small lake, which is usually considered as a part of Rabbit lake, although not on the same level. The path is scarcely half a mile in length, and runs on the north side of the stream, which here trends nearly east and west.

White-bear lake was so called for a former chief of the Timagami band of Indians. As will be seen by a reference to the map it has a very irregular outline, and only a little over three miles of the southwestern part is traversed on the canoe-route to Timagami lake, the greatest portion of the lake lying to the northeast. The principal bays, making up the larger portion of the whole surface, have a trend a little east of north, thus coinciding with the strike of the clastic rocks exposed on the shores.

These are connected by shorter intervening stretches, excavated almost at right angles to the strike of the rocks. The width of a quarter of a mile or a little over is remarkably uniform. The prevailing clastic rock in the southern and western part of the lake is the breccia-conglomerate. The rock is, as a rule, massive and jointed, and the cleavage, which is the only structure visible, has a strike of about north and south with a dip to the east < 60°, according in a general way with the line of outcrop of the greenstone. The greenstone, or diabase as it seems to be, occupies the whole of the western shore of the southern bay, as well as the large island near the eastern shore about the central part of the lake. It also forms the extremity of White-bear point and the high promontory on the south shore separating the eastern from the western portion of the lake. A small mass was likewise noticed on the northwest shore of the lake about a mile southeast of the inlet from Friday and Obashkong lakes.

On the long portage between White-bear and Bogie lake the rock wherever exposed to the usual breccia-conglomerate shows a preponderance of granitic fragments enclosed in a dark greenish-grey chloritic matrix. In the northeastern part of the lake the lowest clastic rock overlying this breccia-conglomerate is a dark greenish grey fine-grained greywacké, having in places a somewhat slaty cleavage corresponding with the bedding. The dip is in general about S. 75° E. < 25°. This passes gradually upward, through an interlaminated lighter coloured feldspathic sandstone, into a yellowish-green or greenish-grey quartzose sandstone or grit, much coarser in texture and more massive in structure than the greywacké.

A short portage intervenes between the shallow muddy bay forming the western extremity of White-bear lake, on the road to Timagami, and another shallow arm of Crooked lake or Kinabigo-sminise (Snake Island lake.) The lake has its greatest length from northwest to southwest of nearly two miles. The rock, wherever exposed, is the massive breccia-conglomerate, in many places containing numerous pebbles and fragments, chiefly of red granite, embedded in a dark greyish compact feldspathic matrix. The strike of the most distinct structural planes, doubtless those caused by pressure, is S. 47° E. with a dip to the northeast < 65°. A portage of less than a quarter of a miles separates Crooked lake from Caribou lake, the trail passing over a considerable rise composed of the breccia-conglomerate.

while another portage of nearly the same length intervenes between Caribou lake and the small bay which marks the northeastern extremity of the northeast arm of Lake Timagami. Caribou lake, or Sagibanwanapikunk is scarcely three-quarters of a mile long and the rock seen is the massive breccia-conglomerate, the same rock continuing over the portage to Lake Timagami. This lake has two outlets, the ordinary and larger one flowing out of the west end into a small bay to the southeast of the one entered by the portage, while during times of high water another small stream flows out of the eastern end into Crooked lake.

Three important tributaries or branches of the Matabitchouan river enter the northern part of White-bear lake. The main branch reaches the northwestern corner of the main body of the lake about half a mile north of White-bear point. This stream takes its rise in Mountain lake, while many important tributaries enter from the west, draining the larger portion of the rocky granite plateau situated between it and the lakes draining towards Lake Timagami. Another stream flows into the small bay marking the northeastern extremity of White-bear lake, affording an outlet to a chain of waters which extends to within a distance of two miles southwest of the Montreal river. The third branch empties into the same bay about three-quarters of a mile to the southwest of the mouth of the last, draining several lakes, the largest of which is known as Waibikaiginaising or Reb lake.

Ascending the main branch of the Matabitchouan a portage of nearly half a mile separates Net lake from White-bear lake into which it flows, the trail being to the northeast of the connecting stream. The lake has a general trend of N. 36° W. and the distance from portage to portage in a straight line is nearly seven miles. The narrows from which the lake takes its name are situated a little over three miles from the White-bear portage. This contraction is a little over half a mile in length with an average width of about two hundred feet. South of the narrows a bay extends from this part to the northeast for about two miles, at the end affording an entrance to a stream that drains a series of lakes to the east and northeast.

To the northwest of the narrows a bay extends to the southwest for about a mile and a half. A comparatively large sheet of water, known to the Indians as Kanichee-kinikisink lake, lies to the northwest of this bay, into which it empties by two outlets, situated about a mile from one another. The northern portion of the lake, towards the inlet, is comparatively narrow, never, as a rule, exceeding a quarter of a mile in breadth, and frequently contracted to a quarter of this distance. The outlet from Thieving-bear lake discharges at a point a few chains from the northern extremity of the lake, while the stream, from Snare and Mam[illegible]ainia lakes, enters this lake nearly a mile to the southwest of this point.

The rock exposed in the southeastern end of Net lake is a massive compact dark greenish feldsp[illegible] sandstone, associated with small areas or masses of intrusive greenstone. This is succeeded to the northwest by a flesh-red granitite of somewhat coarse texture, composed of reddish feldspar, greyish translucent quartz, and a sparing quantity of greenish bisilicate mineral, which was originally biotite and is now almost completely [illegible] chlorite. This rock occupies the whole of the northeastern [illegible] the wide space to the south of the narrows. It also compo[illegible] western shore and the islands with the exception of about [illegible] the vicinity of the narrows, where there are outcrops of [illegible] ark greenish-grey greenstone. The shore-line characterized [illegible] ence of these rocks is fairly bold, in somewhat marked [illegible] rocks prevail. There are no outcrops of r[illegible] to the northwest of the narrows, however, the [illegible] bay which runs to the southwest, show many outcr[illegible] of a [illegible] greenish-grey slaty rock, evidently originally a compact greywa[illegible] h an abundant development of sericite along the planes of cleavage. These slates or sericite-schists have a strike in accordance with the general trend of the bay, which is northeast and southwest.

The southwestern shores of Kanichee-kinikisink are generally composed of a somewhat similar though more compact slaty greywacké, but the northeastern side and many of the islands exhibit greenstone, which seems to be a different portion of the same magma, which to the north and northeast has, for the most part, solidified as a biotite-granite or granitite. The shores of the northern portion of Net lake are composed of a series of rounded rocky points with intervening marshy or grassy bays, the rock everywhere exposed being a flesh-red granitite in which but little of the ferro-magnesian constituent can be seen. Occasional small patches of greenstone were also noticed that appeared to be closely related to the granitite.

A short stream separates Net lake from Thieving-bear lake, with a small rapid near the latter and a much larger one near the former. Thieving-bear lake, or Mako-gimodiwi, has a very irregular outline, being completely enclosed by comparatively low rounded hills of the flesh-red granitite. It has three feeders from the north. The route from Thieving-bear lake northward to Mountain lake follows a succession of five small lakes or ponds, the largest of which is only a little over a quarter of a mile in length, united by small streams. The whole distance is about three miles by the stream and the general direction nearly north. The valley is as a rule somewhat narrow and shallow, the hills on either side sometimes rising abruptly from the water. The rock throughout is the prevailing flesh-red granitite.

Mountain lake has a general trend of a little north of east, and is about three miles in length in this direction. The western half of the lake, out of which the portage goes to Breeches lake, is a long narrow and shallow bay, and the rocks wherever visible are flesh-red granitite. The main body of the lake is nearly three-quarters of a mile wide, while the enclosing rocky shores are everywhere composed of the massive greenstone. The portage from Mountain lake, which here marks the height-of-land between the Matabichouan and Timagami waters, passes over the side of a hill, the highest point on the trail being 160 feet above Mountain lake. Breeches lake, or Kawaganchigamia, is small. It empties into a pond which in turn discharges into a bay of Annima-Nipissing lake. A portage of only three chains separates Breeches lake from the small pond, while another scarcely an eighth of a mile brings the traveller to the large and important sheet of water known as Annima-Nipissing lake.

Ascending the stream flowing into the northwestern bay of Net lake, about four and a quarter miles from the White-bear portage, the channel of the creek is utilized for a little over a quarter of a mile, when a very short carry is necessary to reach Ferguson lake. Duncan lake, the next expansion encountered, is practically on the same level, being separated by about a quarter of a mile of stream with little current. The shores of both Duncan and Ferguson lakes slope gently and show no rock. The second portage going from the west end of Duncan lake at the stream from Petrout lake is about forty-five chains in length, and runs over hills which are composed chiefly of the flesh-red granitite. Within a short distance of the east end of the portage this rock is succeeded by breccia-conglomerate of the usual character, which outcrops on the west short of Petrout lake a short distance north of this portage. On the opposite side of the lake a coarse greenish-grey quartzite-grit may be seen resting directly upon the dark greenish-grey slaty rock. The junction is close to the edge of the water and is sharp, without any of the customary transition from one rock to the other. Both rocks dip to the east at a comparatively low angle. The southern end of Petrout lake is a shallow muddy bay, and the portage into Lily lake is along the boulders in the stream. The rock on the west side of Lily lake is the breccia-conglomerate, showing the usual fragments of red granite, while on the east side the slates, which are above, are themselves overlain by the quartzite-grit that rises into rather high hills a short distance east of the lake.

A portage of seven chains separates Peeshabo lake from Lily lake into which it empties. The rock on the northern and southwestern shores of the lake is the breccia-conglomerate presenting no unusual features. A mass of flesh-red granite ,evidently co-extensive with the one exposed on the southeastern portion of Net lake, comes out on the west shore of the lake, occupying a little over half a mile of shoreline and an off-lying island. On Bogie lake, to the south of Peeshabo lake, the prevailing rock is again breccia-conglomerate. A portage of three chains separates it from Peeshabo lake. A trail nearly a mile and a half long runs from the southwestern end of Bogie lake to a hunting camp on the north shore of White-bear lake, about half a mile northeast of the inlet from Net lake. The rocky ridges over which it runs are all composed of the greenish-grey breccia-conglomerate.

To the north of Petrout lake a portage thirteen chains in length leads into Granite lake, about a mile and a half in length, although it is only about three-quarters of a mile from the portage at the outlet to that at the mouth of the inlet on the east side, about half way up the lake. A short carry of a little over a quarter of a mile of creek intervenes before James lake is reached. Granite lake, as the name implies, is completely surrounded by granite, with the exception of small masses of greenstone on the southern and southeastern shores. The shores of the southern part of James lake show exposures of greenstone, associated with patches and areas of a dark greenish-grey feldspathic sandstone through which it seems to be intrusive. The northern end of the lake is all composed of the flesh-red granitite.

The portage from James lake to Waibaikaignaising lake starts from a point on the east shore of the former, about half a mile north of the outlet. It is nearly thirty-five chains in length, and comes out on the west side of a small basin, forming the southwestern extremity of Waibikaiginaising lake. The outlet of this lake flows to the south from this basin-like expansion, ultimately reaching White-bear lake about three-quarters of a mile southeast of its northeastern extremity. Waibikaiginaising or Reb lake is a little over six miles in length, and has, in general, a trend of a little west of north. About half a mile from the northern end a boulder obstruction, doubtless of morainic origin, runs almost completely across the lake at right angles to its general direction, leaving only a very narrow channel near the western side. The western shore of the lake, wherever rock exposures were seen, is underlain by the breccia-conglomerate presenting the usual dark greenish-grey matrix with embedded fragments and pebbles of eruptive material. The eastern shores of the southern half the lake show rather continuous exposures of the well banded greenish, compact greywacké-slates, upon which is superimposed the coarse yellowish-green quartzite-grit, both rocks dipping to the east $< 25^\circ$. Both shores of the northern part of the lake are composed of the quartzite-grit as far as the inlet from Johnny lake.

The portage into Johnny lake is nearly eighteen chains long and runs to the northeast of the creek connecting the two lakes. Here a mass of greenish-grey diabase intersects the quartzite, rising into somewhat high and precipitous cliffs. This belt of diabase is about half a mile in width and is evidently an extension eastward of the huge mass exposed on the shores of Annima-Nipissing and Mountain lakes. The shores and islands of the northern part of Johnny lake are composed of the massive and compact breccia and conglomerate, much jointed and broken and filled with very numerous pebbles and fragments of various eruptive rocks.

The stream from Cliff lake empties into Waibikaiginaising lake at a small indentation of its eastern side, a little over two miles from the south end. The portage is about thirty chains in length and runs a short distance north of the stream. The canoe-route utilizes only the northern part of Cliff lake, coming in at the northwest corner and going out at the end of the small bay running to the northeast. The lake itself is about a mile and a quarter in length and has a general trend a little west of north. The yellowish-green quartzite-grit rises into high hills on either side of the lake, especially towards the east, where high precipices mark the western faces of hills that rise to an elevation of from 400 feet to 500 feet above the lake. These hills present less abrupt though still steep slopes on their eastern side to the west of Friday lake. The strike of these greenish quartzites runs from N. 25° W. in the southern part of the lake to nearly north at the northern extremity, while the dip is to the east $< 20^\circ$ to 25°. The portage from Cliff lake to Summit lake follows up a steep gully between high ridges of quartzite to the south and others of diabase to the north. The highest point on the trail is 190 feet above Cliff lake and is only six chains west of Summit lake, while the fall towards the latter is seventy feet. The lake itself is only a small pond about a quarter of a mile in length, the outlet flowing from the northeast comes into a beaver-meadow and thence eastwards to Friday lake. The northwest shore of Summit lake is composed of diabase, an extension in this direction of the band crossing the foot of Johnny lake, while the rest of the shore-line shows outcrops of the greenish quartzite. The next portage runs from the northeast end of Summit lake to a beaver marsh, along the eastern margin of which the path runs for some distance, when it turns eastward towards Friday lake

Friday lake is completely enclosed by hills of coarse sea-green feldspathic sandstone or quartzite-grit. The lake has a general direction of a little west of north and is four miles in length, with an average width of a quarter of a mile. A trail a little over half a mile in length runs from a small bay on the east side of the lake, about a mile from the north end, to a small expanse of water that we called Wilson lake and which has the distinction of being the highest lake of which we have a record throughout the entire area of the present map-sheet, being about 1177 feet above the sea.

To the northwest of Friday lake a short portage runs to Prudhomme lake, the southern part of which is extremely shallow and is enclosed by the greenish quartzite, but the narrows beyond show outcrops of diabase which appear to belong to a belt over an eighth of a mile in width, forming a continuation in this direction of the mass exposed to the northwest of Summit lake. Northwestward it runs towards the large mass which characterizes the district on either side of the Montreal river in the vicinity of Horner chute, with which it seems to be continuous. The southwestern shores of the northern part of Prudhomme lake show outcrops of the greenish quartzite striking N. 25° W. and dipping S. 65° W. < 36°, while on the opposite side the underlying slates dip S. 70° W. < 35°.

Between Friday and White-bear lakes the distance in a straight line is about six miles and a half, and the valley occupied by the connecting stream and lakes shows a gradual bending around from a little east of south to southwest. The river shows alternating deep stretches, some of them through extensive beaver-meadows, connected by narrow rocky or boundary spaces which require to be portaged. Five portages at least have to be made before reaching the small lake crossed by Nivens meridian line, to avoid these rough pieces of stream. The stream is utilized for about three-quarters of a mile below this small lake where a portage over half a mile in length is made to avoid the rough and obstructed river. A trail a little over half a mile long runs from the foot of this portage to Bear lake to the east of this point. Below this portage the stream meanders with a comparatively deep though crooked channel for a distance of nearly a mile, when a short portage is made on the northeast side of the stream into Oba-hkong lake. This lake is about two miles in length.

Bear lake, which flows into the Matabitchouan river below Rabbit chute, has a general trend of nearly north-and-south, and is a little over six miles in length. It rarely measures a quarter of a mile in width. The shores are everywhere composed of greenish quartzite with some associated intrusive greenstone at the southern end. There are two outlets, both of which, however, unite in a small lake to the south. The stream is rarely travelled and the country on either side is exceedingly rough and uneven. Three small lake-like expansions intervene between Bear lake and the Matabitchouan, united by rough, rocky and usually rapid channels. The slate which underlies the quartzite is not met with until the immediate vicinity of the Matabitchouan river is reached.

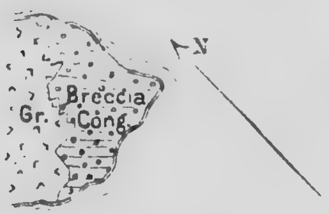
MACDONALD CREEK.

The rocks seen along this stream are particularly interesting and throw considerable light on the structural relations existing between the Laurentian and Huronian. The stream has never been much used as a canoe-route, and therefore need not be described at length. It consists of a series of lakes united by shallow rocky or bouldery channels, which necessitate frequent portages. From the outlet, at the northeast corner of the Fourth Bass lake on the Matabitchouan river, to Moxam lake it occupies a gently curving valley with a general southerly direction, but the extension of this depression southward meets rising land which forms a watershed in this direction. The upper portion of the stream from Moxam to Ross lake occupies a valley trending almost northwest. Ross lake, marking the headwaters, is only a couple of feet lower than Rabbit lake, a decided hollow connecting the two lakes, and during times of freshet a certain amount of the water of Rabbit lake escapes into Ross lake. The first three expansions at the head of this stream, viz: Ross, Burwash and Moxam lakes, differ little in level, and the short stream connecting them exhibits very little current. From Moxam lake, however, down to the mouth, the fall is seventy feet, most of which occurs between Cooper lake and the Matabitchouan, this distance of a little over half a mile showing a fall of fifty feet.

The shores of Ross lake are composed of a coarse red granitoid-gneiss, evidently by its composition a granitite. Some portions are more basic in composition and darker in colour where the biotite has segregated during its consolidation, and these patches or areas show a very distinct foliation. In some outcrops the rock is porphyritic and the phenocrysts of flesh-red feldspar are developed in a finer-grained feldspathic groundmass showing streaks of yellowish-green epidote. At one point on the west shore a mass of fine-grained greenstone was seen associated with the granite in such a way that both had apparently solidified from the same magma, differing only in their rate of cooling. The gneissic rock is certainly newer than the greenstone, irregular dike-like masses of the former penetrating and ramifying through the latter.

The point on the southeastern shore of this lake towards the outlet is occupied by the prevailing breccia-conglomerate holding pebbles chiefly of reddish and reddish-grey granite. These inclusions vary greatly in size, some being as much as three feet across. Occasional fragments are quite angular in outline, some are subangular, while the majority have been more or less perfectly rounded. The contact between this comparatively small area of clastic rock and the granitite-gneiss in which it is doubtless embedded was not seen, although only a short distance intervened between the exposures of the two rocks. The greater portion of the small island in the southern part of the lake is composed of coarse reddish granitite-gneiss. The island runs in a northeast direction and is about three chains in length. Its northeastern point is composed of the breccia-conglomerate, full of small pebbles as well as angular fragments, chiefly of red and grey granite. The contact between the two rocks is sharp and jagged and re-entering angles filled with the material of one rock penetrate the substance of the other.

FIG. 4.



Scale 40 ft. inch.
SKETCH SHOWING THE LINE OF JUNCTION AT NORTHEAST POINT OF SMALL ISLAND IN BASS LAKE.

The rock near the northwest end of Burwash lake is, as a rule, well foliated and of a deep flesh-red colour, the strike being N. 19° E. and the dip northwest at a high angle. Some of the gneiss is very massive and granitoid, in places porphyritic, the phenocrysts of feldspar being very sharply outlined in a dark-greenish chloritic matrix. This rock seems to be the prevailing flesh-red granitite-gneiss, the biotite originally present being decomposed to chlorite. Similar rock is pr sent on the northwest shore of Moxam lake, striking N. 29° E. and dipping southeasterly < 60°.

On the southeast side of Moxam lake, in the southern part, and al in the bay running to the southeast, the gneiss is not only very di tinctly foliated, but well laminated. It is the usual interlaminatio of the reddish and greyish granitite, presenting the common altern tion of lighter and darker coloured bands. The strike is N. 48° E. and the dip southeast < 53 .

The gneissic rocks in the vicinity of the narrows in the northeaster part of the lake show a gradual curving around in strike from N. 4 W. at the southern end to N. 40° E. a little to the north of this co traction, while the angle of inclination varies from 45° to 60°. At on point on the northwest shore, nearly three-quarters of a mile from th outlet, the granitite-gneiss is of a deep flesh-red colour weathering on exposure to a brick-red. It is massive, distinctly foliated, but much affected by jointing, so that it is exceedingly difficult to obtain a hand specimen. Small patches of a dark-green chloritic slate are embedded in this rock, running for the most part with the foliation. The slate is evidently much altered and full of shearing planes, which are abundantly coated with the usual greenish products of alteration. This clastic rock contains small lenticular granitite dikes, besides some ill-defined areas of a similar rock somewhat coarser in texture, that doubtless represent squeezed and stretched pebbles and fragments. The hand specimen from which the thin section examined was taken shows a dark-green slaty rock penetrated by tongues or dikes of a dark-red felsite. Under the microscope the dark-green portion is seen to be a typical clastic rock with subangular and rounded fragments of orthoclase, plagioclase and quartz embedded in a finer-grained groundmass composed chiefly of epidote and chlorite, which have doubtless resulted from the mutual reaction of the feldspar and bisilicates originally present. Sphene in irregular grains, and some pyrite, were noted scattered through the section. The little tongues or dikes of felsite are seen to be composed of orthoclase and quartz chiefly, together with some plagioclase. The minerals are much bent, cracked and broken, and have been recemented by chlorite and epidote. The whole rock has been profoundly sheared and has evidently been derived from a fine-grained greywacké formed from the degradation of a granite, this rock being subsequently penetrated by the fine-grained felsite dikes. These dikes are all intensely shattered, and the feldspar affords beautiful examples of twinning striations resulting from pressure. The cracks are filled with sericite, chlorite and epidote.

On the shore southeast of the island in the northern part of Moxam lake the gneiss is very evenly foliated by the alternating sequence of massive red feldspathic layers, which in themselves show marked parallelism, and dark-green chloritic bands, the whole dipping S. 47° E. < 75°. A few chains to the northeast the ordinary greyish granitite-gneiss with very even foliation dips S. < 40° E. 40°. At a point on the east side of the lake a little over an eighth of a mile from the outlet there is a dark-green distinctly bedded rock (greywacké) associated and interfoliated with bands and irregular patches of the massive reddish granitite-gneiss intrusive through it. The rock resembles very closely a highly altered feldspathic sandstone, when broken phenocrysts of feldspar were noticed embedded in the greyish groundmass. The strike of the foliation is N. 13° W. and dip N. 77° E. 70°.

On the opposite side of the lake also the dark-red massive granite-gneiss contains a good deal of the highly altered greenish-grey slaty rock. At the lower end of the portage going north from Moxam lake the usual reddish granitite-gneiss occurs, striking N. 30° W., and dipping east < 50°. Apparently caught up in the mass of this gneiss are some patches of dark-grey slaty rock, very much hardened and altered and beautifully banded by the occurrence of layers rich in yellowish-green epidote. To the north of this, almost in the bed of the stream, are outcrops of similar gneiss containing many dark-greenish bands composed chiefly of chlorite and epidote. They doubtless represent portions of highly altered clastic material and associated with these are some larger irregular patches of undoubted feldspathic sandstone. These smaller interfoliated bands have evidently undergone extensive recrystallization, thus masking their original structure, but this stratified appearance is in marked contrast to the intrusive aspect of the granitite-gneiss. The foliation, produced essentially by pressure, has a strike of N. 2° W., and a dip easterly < 65°. A little north of the mouth of this creek outcrops of the massive red granite-gneiss contain squeezed fragments of clastic material often of very irregular outline, the strike of the whole exposure being N. 21° E.

On the east side of the small lake below Moxam lake a rock composed of alternating folia of red and dark-green material was seen striking N. 2° W., and dipping to the east at a high angle. A similar rock outcrops at the southern end of Glasford lake, the strike being N. 9° W., and the dip towards the east < 60°. The hand specimen examined showed a foliated rock consisting of a fine-grained chloritic groundmass of a dark-green colour, through which runs irregular wavy tongues of a bright red, fine-grained felsitic-looking rock. In its microscopic character it bears a marked resemblance to the rock occurring on the west shore of Moxam lake, but in the case of the chlorite which is abundantly developed throughout it, its origin is plainly seen to be from hornblende (cores of this mineral occurring surrounded by the chlorite.) The feldspar is very turbid and is stained throughout by oxides of iron; a bright yellow, strongly pleochroic epidote is very abundant in the section.

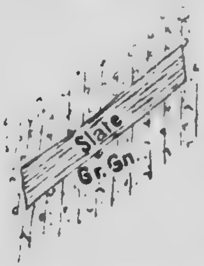
The southern part of Glasford lake is occupied by the massive red gneissic granite which seems to be composed chiefly of flesh-red feldspar and greenish chlorite or hornblende, or perhaps both. The strike curves around from north to northeast with an easterly to southeasterly dip 45° to < 60°. This is followed by a compact greyish slaty rock with granite inclusions, some of which are pebble-like in outline and appearance, while others evidently represent approximately parallel small lenticular intrusive dikes of the neighbouring granitic rock. This characterizes the shore for nearly a quarter of a mile, and may represent a tongue or extension of the main mass of similar Huronian strata to the southwest.

To the northward it may be continuous with an outcrop of breccia-conglomerate that occurs on the west shore of Cooper lake, near its southern end. The northern part of Glasford lake is occupied by massive red granitite-gneiss, with which is associated some greenstone, such areas seemingly representing the primary or first formed secretions from the same magma, the cooling of which produced the associated granitite-gneiss. From this to the second little expansion below Glasford lake gneiss is the prevailing rock, the strike being N. 19° E. At one point in the narrows this gneiss contains bands and small irregular inclusions of a dark-green hornblendic rock. The inlet into Cooper or McDonald lake is occupied by a massive red and reddish-green, often porphyritic, granitite-gneiss, striking N. 3° E. and N. 11° E., and dipping to the east at high angles.

The shores of Cooper lake are occupied chiefly by a flesh-red granitite-gneiss, in some cases porphyritic, weathering greyish, especially when burnt over. The foliation, which is not very apparent in places, is sometimes brought out more strongly by the more or less parallel alignment of certain ill-defined patches of more basic material. The rock is composed essentially of flesh-red feldspar, chiefly orthoclase, and more or less greyish quartz, this latter material being often present in vein-like streaks and patches, evidently pegmatitic both in origin and structure. The little ferro-magnesian material present is apparently biotite, which has undergone somewhat advanced chloritization. This is associated with a massive medium-textured greenstone, the irruptions of the two rocks evidently being very closely synchronous. The prevailing strike of the foliation, wherever apparent, is from northeast to southwest. On the west shore of the lake, south of the narrows, a patch of the dark greenish-grey breccia-conglomerate comes in, apparently forming a huge mass caught up during the intrusion of the granite. It contains the usual pebble-like and other forms of granitic material, while the matrix in which these are contained has the customary dark greenish-grey colour. This rock occupies the shore for about an eighth of a mile. The contact between this clastic and the red granitite-gneiss to the north is irregular and ill-defined, irregular dike-like forms and patches of the latter penetrating the mass of the slate. The bedding of the slaty rock abuts on the dim foliation of the gneiss, the slate striking N.N.W., while the direction of the foliation of the granitite-gneiss is southwest.

This patch of slate is interrupted to the south by a red, very feldspathic, granite, which continues along the shore for about six chains, when it in turn gives place to the dark-greenish slaty rock, similar to the mass already described, which occupies this side of the lake to its southern extremity, where the low ground conceals the rock beneath. These masses may either represent detached portions of the clastic Huronian strata caught up and floated off during the intrusion of the association granitite, of whose irruptive character there cannot be a doubt; or, on the other hand, they may belong to a band or tongue co-extensive with the main mass of similar clastics to the southeast, but whose continuity at the surface is broken or concealed by the dense forest growth. The island in the narrows of this lake, as well as the west end of the comparatively large island to the north, is composed of a greenish-grey greenstone or diabase. At the outlet of Cooper lake the foliation of the prevailing granitite-gneiss is marked by the parallel disposition of plates and aggregated patches of chloritized biotite. It is sometimes rather obscure, and the rock is very massive and granitic in character. The strike is N. 3° E. Embedded in this gneiss and crossing its foliation is a rudely rectangular mass of a greyish slaty greywacké. The mass is about two feet wide by about fifteen feet in length, the direction of its longer diameter being about northeast, while the foliation of the gneiss is only a few degrees east of north.

Fig. 5.



The rough and bouldery stream which separates Cooper lake from the Matabitchouan river shows outcrops of the massive reddish gneiss, the strike apparently being about N. 13° E. At a narrow gorge, through which the stream runs, a patch of greenish chloritic and epidotic schist was noticed embedded in the intrusive gneiss. The hand specimen showed a dark-green, rusty-weathering, compact, foliated chloritic rock, with numerous minute particles of pyrite scattered through it. The microscope shows it to be a typical epidotic and chloritic schist in which all traces of the original structure have been destroyed. It bears a close resemblance to those described by Dr. F. D. Adams, from the Eastern townships,* and consists of a schistose aggregate of feldspar, quartz, pale-green chlorite, epidote and pyrite. The epidote is in granules of varying dimensions, and also in crystals, which present sharply defined rhombic sections. It is strongly pleochroic. The chlorite forms pale-green folia, running through the fine-grained mosaic of quartz and feldspar forming the groundmass of the rock. Many of these schists have been proved in other regions to have resulted from the shearing of a basic eruptive, and it is quite possible that this rock has had just such an origin, but, on the other hand, taken in conjunction with the other occurrences of very similar, though perhaps less altered patches of stratified material just described as having been caught up in the gneiss, it probably represents a completely recrystallized basic greywacké-slate.

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*Report of progress Geo. Surv. Can., 1880-2

Between this point and the Matabitchouan there is only another rock exposure consisting of the breccia-conglomerate, situated on the west side of the small bay into which Macdonald creek discharges, and about thirty chains to the southeast of the main channel of the river. The junction, therefore, between the granitite-gneiss, here constituting the Laurentian, and the slaty breccias of the Huronian may be put down with tolerable accuracy as running across the southeastern end of this small bay.

OTTERTAIL CREEK.

Ottertail creek (Nikig-wai-no-wai-sipi) rises in a number of small streams, draining the extensive swamps that occupy the greater portion of the northwestern corner of the township of Hammell, as well as nearly the whole of the timber limit 21 E. situated to the north of this township. The main branch of the creek may, however, be stated to take its rise in a small swampy lake, situated in the fifth concession of the township of Hammell on the line between lots 8 and 9. The distance from its mouth, nearly four miles north of the Opimika narrows on Lake Timiskaming, to this small lake, is about twenty miles in a straight line bearing S. 50° W., but following the bends of the stream this distance is increased to a little over thirty miles. The most important branch, however, forming as it does a portion of the route occasionally used by travellers to reach the interior, takes its rise in a small beaver-pond a short distance north of the northern boundary of timber limit 12 E. This pond is separated by a portage of only a quarter of a mile from another small expansion known as Bush lake, that flows into the Martin river about three-quarters of a mile southwest of the inlet from Mackenzie lake. The distance from this small beaver-pond to the mouth, following the course of the stream, is twenty-two miles and a half, but in a direct line, bearing S. 71° W., it is only a little over sixteen miles.

The first portage on the route inland by way of this stream starts from Grenier's clearing, a short distance north of the mouth of the stream, and is a little over a mile in length. It runs from the valley over the high hills that border Lake Timiskaming. The upper portion of these hills shows the usual hummocky outline which elsewhere occurs with extended exposures of the reddish gneiss. This rock is massive and granitoid in appearance, but distinctly foliated, the strike being to the northeast while the dip is to the northwest < 65°. The highest point on this portage is 365 feet above low water on Lake Timiskaming, while the creek reached by the west end of the portage is 180 feet above the same datum. The descent, therefore, towards the creek, though less (285) than that towards the lake, is very abrupt and steep. Four more portages intervene before the lake at the forks is reached, these showing a combined fall of nearly eighty-four feet. The portages are all on the northeast bank of the river and are short, the longest being a little over half a mile. These are to overcome low rapids caused chiefly by bouldery obstructions. Between these rapids the creek is comparatively deep and about twenty yards in width, flowing with a gentle current between banks composed of coarse, yellowish sand. The rock, wherever exposed, is the common granitite-gneiss, very massive and granitoid in structure, but with distinct foliation, striking N 30° E., and dipping to the northwest <65°.

The main forks, where the north branch joins the main stream, is about four miles from the mouth, the creek throughout this distance having a general course of N. 76° W. The lake at this fork represents in reality the last stretch of the north branch before it enters the main stream. The name Wabamik, by which it is known to the Indians, refers to the legend that a huge white beaver formerly lived on its shores. The immediate banks of the lake are for the most part low and marshy, but two exposures of rock which were noticed resembled the massive reddish granitite-gneiss striking N. 35° E., and dipping to the southeast < 70°. A few hills rise to the south of the forks, but at a considerable distance away from the creek, while the valley of the creek immediately above is wide and level. To the southwest of the lake a rather prominent hill rises in close proximity to the shore, while to the northeast the numerous rounded rocky ridges of the usual flesh-red granitite-gneiss rise from 200 to 250 feet above Whitebeaver lake.

Between the forks and the intersection of the Lake Timiskaming colonization road the distance by the stream is about eleven and a half miles. In this distance there are nine portages, to overcome as many rapids and chutes. Seven of these are low rapids where the stream is obstructed by boulders, while two are chutes, the channels being comparatively narrow and cut for the most part along the strike of the foliation of the gneissic rock. The intervening stretches of quiet water, between these interruptions to navigation, average nearly a chain in length, the water being tolerably deep, and the banks on either side fringed with a dense growth of alder and willow. The stream in many places pursues a rather tortuous course through the narrow sandy flat, although some of the more prominent bends reach the solid rock on either side of the valley.

At the first rapid above the forks the stream falls about ten feet through a gorge excavated in flesh-red granite-gneiss, well foliated and laminated and striking N. 38° E., while the dip is to the southeast < 45°. The gorge or cañon runs for the most part with the foliation, but at one place it breaks across the strike of the gneissic rocks. At the lower end of the third portage the gneiss is the dark-grey, almost black, variety, which is at once hornblendic and micaceous, and to which the name quartz-mica-biotite has been applied. It is a glistening evenly foliated gneiss stained in places with iron oxide. The strike at this place is about northeast, thus corresponding with the general trend of the stream. Under the microscope the rock is seen to be composed of plagioclase, orthoclase, quartz, hornblende and biotite with sphene, apatite, zircon, pyrite and limonite as accessory minerals.

At the sixth portage (made to overcome a rapid which also flows through a rocky gorge cut out along the strike), the rock is dark-grey and micaceous, well laminated as well as foliated and striking N. 22° E. with a dip to the southeast < 45°. At the seventh portage the rock is the fine-grained reddish granitoid variety, doubtless a granitite-gneiss. Between the bridge on the Lake Timiskaming colonization road and the forks with the main branch above there are three obstructions in the stream. Two of these are caused by boulders, but the third, which is intermediate between the other two, shows a descent of nearly thirty feet with a portage on the south side. The rock at this place is massive and much jointed, and represents the prevailing red-granitite-gneiss. At the third rapid above the bridge the rock present is massive, rather fine-grained, reddish in colour and distinctly gneissic in structure. The thin section under the microscope shows it to be a granitite-gneiss, composed of orthoclase, plagioclase, microcline, quartz, biotite and primary epidote, the orthoclase being by far the most abundant constituent. The accessory minerals noted were apatite, zircon and sphene.

A short distance above the rapid the surface of the country flattens out, while the creek itself, for a distance of over two miles, pursues a tortuous course through an extensive beaver-meadow, and numerous beaver-dams obstruct navigation. It is expedient to make one long portage avoiding this portion of the creek and coming out at the southeast end of Ruth lake. Ruth lake, and the beaver pond beyond, marking the head of the Ottertail in this direction, are practically on the same level, and the portage connecting them runs on the southwest side of the creek. On this portage some birches, over nine inches in diameter, which had been felled by beaver, were noticed. The strike of the rock in Ruth lake is about southwest. It shows the usual alternating reddish and greyish bands which, in themselves foliated, give by their even and parallel disposition not only a very marked foliation, but a distinct lamination to the whole mass. Under the microscope a specimen obtained from the northeast shore shows the rock to be of the variety here designated granitite-gneiss. It is composed of orthoclase, microcline, plagioclase, quartz-biotite and primary epidote with apatite, zircon, sphene and a little iron ore as accessory minerals.

From Ruth lake a portage a little over a mile and a half in length runs to Fanny lake, at the headwaters of one of the tributaries of the Martin river. The southwestern end of the portage passes over a somewhat low, though in places rocky tract, grown up with small trees. There is little soil, and the rock, when exposed, was seen to represent red and grey banded granitite-gneiss. The last half-mile near the northeast end of the portage approaching Fanny lake is over lower land, very marshy in places.

The portage from the beaver-pond to Bush lake is about a quarter of a mile in length and the barometer showed the latter to be ten feet lower than the beaver-pond. The shores of Bush lake are comparatively high and for the most part rocky. A hill rises close to the southwest shore of the lake to a height of about 150 feet. The rock which is frequently seen is a granitite-gneiss, well foliated, but somewhat massive and granitoid in structure. The strike is N. 45° E. and the dip southeast < 50°. The portage from Bush lake to the Martin river, into which it empties, shows a fall of about forty feet. The trail starts from the northeast side of the creek, but crosses over to the southwest side. It shows evidence of having been but slightly used. Indeed the whole route inland by way of Ottertail creek is but little known and therefore rarely used, and as the beavers have been nearly all exterminated in the vicinity of its banks it has been but little frequented of late years for hunting purposes. Occasional beavers, however, still reside along the course of the creek, as abundant work done quite recently showed.

Bay lake to Lake Timagami, by way of Annima-Nipissing, Carrying, and Red Squirrel lakes.

This route commences at a small marshy bay on the southwest side of Bay lake, about one and three-quarter miles southeast of Bay Lake post. The narrow and crooked, though navigable channel of the small inlet that enters the lake at this point is followed a short distance to the foot of the portage. The portage is in reality a winter road, built in 1881 by Father Paradis to take in supplies from Bay lake to Timagami, and is a little over one mile and a quarter in length of almost continuous climbing, reaching Annima-Nipissing lake at the extreme northeastern corner. The trail follows up a valley, which, as the summit is approached, becomes very narrow, the hills of [illegible] on either side approaching each other very closely, while [illegible] of angular blocks detached from the [illegible] above still further [illegible] the narrow pass. At the summit a sort of *cul de sac* occurs, the [illegible] slope facing towards Bay lake, but once this sharp incline of [illegible] feet is surmounted there is a gradual descent of about ten feet to Annima-Nipissing lake. This lake is about one hundred and [illegible] feet above Bay lake or 1075 feet above the sea, while the highest point on the portage, only a short distance from Annima-Nipissing lake, is only ten feet higher.

Annima-Nipissing or [illegible] lake, (the [illegible] head of the Nipissing waters), runs in a general direction [illegible] 30° W. for nearly ten miles. It is separated from [illegible] lake [illegible] west, by a small narrows, containing a rapid, and which [illegible] showing a decrease in level of about two feet, is sometimes [illegible] as forming part of the larger expanse. This important [illegible] is divided into three portions, separated by two narrows. The northerly of these stretches has a length of four miles [illegible] quarters and varies from a quarter of a mile to a mile in [illegible]. The central portion is much smaller and presents a much more irregular outline. One of the bays running to the southeast affords an entrance to an inlet from Breeches lake, on the road to Mountain lake, at the headwaters of the main branch of the Matabitchouan river. A somewhat longer arm running a little west of south approaches very close to the waters of Mannajigama lake, while still another extension, running to the northwest, receives the small creek from Pickerel lake, from which it is separated by a portage only a few chains in length.

The southern part is about three miles and a half in length [illegible] over half a mile wide. It likewise has an irregular shape, a large [illegible] running to the northwest for nearly two miles from the north[illegible] end of the stretch. About a mile and a half from the outlet into [illegible] lake a small stream enters, forming the outlet of Whitewater and Diabase lakes. Several soundings were taken in places reported to be exceedingly deep. One of these places, situated about the middle of the lake, opposite Crow rock and a little over a mile from its northern end, showed a depth of ninety-three feet, while another sounding, taken about the middle of the large open space in the central part of the lake, gave 100 feet. The water has the clear and limpid character and light sea-green tint of Timagami, although in point of clearness and purity both these lakes are excelled by Whitewater lake, lying to the west of the southern part of Annima-Nipissing lake.

The coarse quartzite-grit or arkose occurring on Bay lake extends to the tract passed over by the portage entering the north end of Annima-Nipissing lake. It also extends down the eastern shore of this lake for nearly three-quarters of a mile, when it gives place to a coarse gabbro that occupies the shore for over a mile farther south. The rock, as here exposed, is rather coarse in texture, and is characterized by the presence of reddish feldspar, in this respect resembling certain portions of similar irruptive masses to the northwest of Bay lake, as well as at Quinn point on the east shore of Lake Timiskaming. Near the line of junction with the gabbro the quartzite has been considerably altered by its intrusion, the alteration consisting chiefly in a hardening due to the secondary enlargement of the original quartz grains and the deposition of interstitial silica. On the west side of the lake this arkose forms a perpendicular cliff about a hundred feet in height, known as Crow Rock, and, continuing down along this shore occupies the greater part of the southern shore of the bay running to the southwest. The large island, as well as the much smaller one to the northeast, is composed of massive greenstone or gabbro, but the island lying close to the shore to the southwest of these is formed of the slaty greywacké, underlying the arkose. On the point to the southwest of the large island a considerable inlier of banded slate appears to have been caught up in the mass of the greenstone during its irruption, and the bedding of the slate, well marked by the alternating colour-bands, shows an inclination N. 50° W. < 15°.

The relative distribution of the greenstone and slaty greywacké, the latter being the prevailing clastic rock, is shown on the map. The diabase gabbro forms a series of high hills which are in marked contrast to the flat topography characteristic of the areas underlain by the slates. On the west side of the lake this greenstone sometimes forms the shore-line, while elsewhere it is replaced by a strip of the slaty greywacké only a few chains in width. The clastic rocks in this portion of the lake have a prevailing dip to northeast or north-northeast at a low angle, usually less than 10°. The southern and southeastern shores of the central portion of the lake show somewhat extended exposures of greenstone, both gabbro and diabase being present in the same mass. To the south these rocks seem to merge gradually (through a massive greyish or pale-pinkish gneissic granite well exposed on Mannajigaina lake), into the mass of flesh-red granitite and granitite-gneiss that prevails over such a large area to the south and southwest. The field relations of these several rock-types seem to furnish considerable proof that all three have originated from the same magma, differing only in their rate and manner of cooling. The irregular point of land on the northwest side of the lake, between its northern and central portions, as well as the extreme point on the east side of the narrows, is composed of rather flat-lying slaty strata. On the west side of the southern stretch of Annima-Nipissing lake is a range of hills composed of irruptive material, chiefly a rather coarse-grained granite.

Closely associated with the last-named rock is that to which the name breccia-conglomerate has been applied in this report. The matrix is, in general, a dark greyish-green chloritic and epidotic greywacké, enclosing numerous fragments of various irruptive rocks, those of flesh-red granite being the most abundant. These are often quite angular in outline, occasionally showing re-entering angles, although usually they possess a more or less perfect rounded outline. These larger fragments include pieces of flesh-red feldspar and greyish quartz or quartzite, red and reddish-grey granite, fine and medium-textured diabases and sometimes diorites of several species. Occasionally fragments of a greenish slate, apparently identical with some classified as Huronian, were also noticed. This coarse material is occasionally so abundant that little of the finer matrix is represented, while, elsewhere, only an occasional pebble or fragment was noticed, the rock passing upward into a distinctly banded slate, which is usually entirely free from such inclusions

The greater portion of these hills is composed of a very pale flesh-coloured granite, which is associated with and apparently merges into a greenstone or diabase. One point shows a prevalence of the granite with bands and patches of the greenstone scattered through it, while other outcrops, not very remote, exhibit a preponderance of the greenstone, with irregular dike-like forms of granite penetrating it in all directions. Both granite and greenstone invade the breccia, while fragments of the latter are caught up in both of these intrusives. The contact between what is evidently a pyroclastic rock and the igneous intrusives is a curious wavy line, which in places can be laid down with exactitude, while a short distance away there is apparently a commingling of the two rocks through fusion, that causes a seeming transition from one to the other. The history of the formation of these several rocks would seem to indicate that the granite and greenstone represent differentiated irruptives forming the original deep-seated portions of an old centre of volcanic activity, which subsequent erosion and denudation have exposed at the present surface. The breccia-conglomerate, on the other hand, doubtless constitutes the lower portion of the associated volcanic breccia, formed by the accumulation and consolidation of portions of the various strata rent asunder during the progress of the eruption, this resulting pyroclastic material being spread out upon the bottom of a shallow ocean, where it has become rolled, sorted, and possibly mixed with ordinary aqueous sediments. The overlying slates show very little sign of aqueous abrasion, while in their composition and appearance under the microscope they closely resemble fine-grained tuffs, representing the consolidation of the first volcanic ash beds.

Whitewater lake (Kawabi-h-kagama) is an irregular sheet of water running in a general direction of a little north of west for about three miles. It empties from the west into Annima-Nipissing lake about one mile and a half northeast of the outlet into McLean lake. A short portage, over exposures of breccia-conglomerate, follows to the north of the discharging creek. A belt of diabase runs from the western shore of Annima-Nipissing lake to the south of this lake, forming the points of the small peninsulas near the west end of the lake, and connecting with the large mass of similar rock to the west and north. The clastics associated with this greenstone include the massive dark-greenish-grey greywacké with or without large enclosed pebbles and fragments. Diabase lake, about a mile in length, is separated from Whitewater lake to the south, into which it empties, by a short portage, and, as its name implies, is completely enclosed by greenstone that to the northwest of the lake rises into considerable hills. Gull Rock lake is reached by a portage considerably over half a mile in length from the northwest end of Pickerel lake. It is so shallow that the Indians assert that during severe winters it is frozen solid to the bottom. Its outlet, leaving the northwest angle of the lake, flows into the Montreal river a short distance below Pork rapid. It is completely surrounded by low hills of the coarse quartzite-grit or arkose.

Mannajigaina (Ugly-running) lake and Snake lake (Nakwaganak) lie a short distance to the southeast of the southern part of Annima-Nipissing lake, the former being reached by a portage about thirty chains in length, running from the extremity of a bay on the east side of Annima-Nipissing lake, about two miles and three quarters from its outlet to McLean lake. The shores and islands of Mannajigaina lake which runs west for about two miles, are composed of a greyish and pale flesh-coloured gneissic granite, the foliation, though at times somewhat indistinct, being nearly always discernible. Snake lake the lower of these two expansions, is also surrounded by a very similar intrusive rock, with the exception of the southeastern corner, where a comparatively large patch or area of the breccia-conglomerate is exposed. The immediate shore-line, on this side of the lake, is occupied by a narrow strip of granite, while immediately to the south the breccia-conglomerate forms a rather high hill, with a dip to the south < 8°. The contact between the breccia and the granite is at times very sharp and distinct, when it exhibits a curved or sinuous line, but at other times there is a narrow brecciated zone, caused by the invasion of the breccia by the granite and the inclusion of fragments of the former in the latter.

The eastern shore of the southern part of Annima-Nipissing lake is composed of the dark greenish-grey greywacké-slate, containing fragments and pebbles of granite and other irruptive rocks. The slaty rocks characterize a band on this shore varying from an eighth to a quarter of a mile in width, while the southeastern part of the two small bays that indent this shore-line show continuous outcrops of a flesh-red gneissic granite. On the south shore of the more northerly of these two indentations the immediate contact between the granite and the slates was noticed, the latter rock dipping N. 50° W <50°, while the foliation of the granite has an inclination S. 57° E. <70°. At the foot of the more southerly of the two bays the foliation of the granite-gneiss has a strike of N. 47° E., and a dip to the northeast <45°.

The greater part of the northwestern shore of McLean lake is composed of very much squeezed and altered chloritic greywacké-slate. This likewise occupies the points on the southeastern shore, but the granite-gneiss crops out all along the bottom of the bays as well as along the sides towards the south and southeast. The portage from McLean lake to Carrying lake (Kecheonai) is nearly thirty-five chains in length, and the rock, abundantly exposed, is a coarse flesh-red gneissic granite, the foliation being marked by the parallel disposition of chloritized scales of biotite. In composition the rock is a granitite, being composed chiefly of orthoclase, quartz, biotite decomposed to chlorite, with smaller quantities of epidote and sphene. The strike of the foliation on Carrying lake is N. 42° E., with a dip to the southeast. The contact between the granite and the breccia-conglomerate runs across Carrying lake near its centre, the clastic rock having a strike of N. 72° E., and dip to the northwest <60°.

The portage into Red Squirrel lake (Atchimo) is over half a mile long, and shows, at the beginning, exposures of breccia-conglomerate. Outcrops of the same rock are very abundant on Red Squirrel lake, and on one of the small islands the granitic and diabasic fragments and pebbles are so abundant that very little of the dark-greenish chloritic matrix can be seen. On the southeast side of the lake this rock rises into hills about three hundred feet in height, dipping S. 17° E. < 45. To the west and southwest of Red Squirrel lake steep hills of diabase rise to a height of nearly four hundred feet above it. The portage from Red Squirrel lake runs to a small marshy expansion of the Annima-Nipissing river, starting from the end of a small bay on the west side in which is the outlet.

The trail is about fifty chains in length, crossing the Annima-Nipissing river or outlet by means of a small rocky island about a quarter of a mile from the lower end. The rock at this point is the prevailing breccia-conglomerate containing chiefly granite fragments. Between Red Squirrel lake and the crossing of the river the portage passes over a sharp and steep esker-like ridge of sand that runs abo north-and-south, corresponding with the direction of ice-flow in this locality. From the foot of the portage it is nearly three quarters of a mile down the stream to its mouth on Sandy inlet at the north end of Ferguson bay on Lake Timagami.

Sharp Rock Inlet (Timagami) to Mattawapika (Montreal River.)

Nonwakaming and Lady Evelyn lakes, which occupy this interval, have of late years become rather well-known topographical features, as they form a considerable portion of a favourite canoe-route between Lakes Timiskaming and Timagami, commencing at the long portage which runs from Haileybury post-office to Sharp lake. The distance by the Haileybury route, following Sharp and Mud lakes and the Montreal river, is about seventy miles, to the Hudson's Bay Company's post on Bear island in Lake Timagami, while from the mouth of the Matabitchouan river on Lake Timiskaming to the same place the distance is only forty-three miles following the canoe channel.

The first portage from Lake Timagami to Nonwakaming lake is about a quarter of a mile in length and is situated on the northeast side of the stream, which, during the earlier months of summer, only serves as a northern outlet of Lake Timagami. The trail is strewn with angular fragments of the subjacent light-green banded slate, this fact having suggested the name of "Sharp-rock portage," by which it is known. Nonwakaming lake is sometimes also called Diamond lake. The first-mentioned name is of Chippewa derivation, referring to the fact that five portages afford an exit from the lake in as many different directions. These include, first:—one running to the south easteast towards Lake Timagami. The western bay affords a route going to the southwest towards Wakemika lake and another to the northwest, a long portage connecting the waters of this lake with an e pansion that empties into Sucker-gut lake. The two other trails issue from the northern bay, one running northwest to Sucker-gut lake, while the other turns to the northeast into Lady Evelyn lake. From Sharp Rock portage to the route affording an entrance to Lady Evelyn lake the distance is three and three-quarter miles, in a general direction a little west of north, the portage and the outlet of the lake being situated close together on the east side of the lake, about three-quarters of a mile from the end of the long bay that extends in this direction.

The larger part of the area of the lake is an arm running in a direction a little north of west for about five miles with an approximate average width of half a mile, ending in two subsidiary bays, the smaller one running to the northwest, while that to the southwest continues for nearly two miles farther. The eastern side of the lake is flat and the ends of the bays are low and marshy, while the shores along the west side present the steeply-sloping sides of bold rocky hills that come close to the edge of the water.

The rock exposed on the east shore is an evenly banded greenish slate, the planes of cleavage corresponding with those of the bedding. This slate occupies the whole of that shore as well as the two smaller islands close by. In strike it exhibits a gradual curve of N. 20° W., in the southeastern part, to N. 20° E. in the vicinity of the portage going to Lady Evelyn lake; while the angle of dip, always in a westerly direction, changes from 8° in the southern portion to 45° along the east side near the north end. This rock exhibits a transition upward through a more massive dark greenish-grey slaty rock, that occasionally shows the colour-bands so characteristic of the strata beneath, into a compact greenish feldspathic sandstone, which, in turn, merges above in a rather coarse quartzite-grit or arkose. The gradual transition is well shown on the two larger islands situated near the centre of the open space formed by the junction of the several bays. The arkose occurs in very thick beds, generally well jointed, but so massive that, usually, it is difficult to ascertain its true dip or strike. As a rule the rock is of a pale yellowish-green or greyish colour. The fragments usually apparent to the eye consist of a pale reddish or greyish feldspar with a much larger proportion of greyish or colourless quartz, embedded in a matrix composed chiefly of minute scales of yellowish sericite. In places along the north shore of the western bay some of the beds are of a distinct flesh-red colour, being with difficulty distinguishable from ordinary granite, from the degradation of which they have evidently been formed. Under the microscope this phase of the rock is seen to differ from the prevalent greenish type, in that the feldspathic and quartzite fragments are little rounded and accompanied by little sericite.

This quartzite-grit occupies the shores of the western bay of Nonwakaming lake, exhibiting a prevailing dip to the east of northeast <12° to 15°. The small bay forming the southwestern end of the lake shows an intricate labyrinth of narrow channels, separated by small rocky, hummocky or subangular masses of the quartzite-grit, the brook emptying the little expansion to the southwest through a narrow valley of a somewhat similar character. The rocky portage, which is scarcely a quarter of a mile in length, leads to a little lake which is completely enclosed by ridges of the arkose. The trail from this pond to the northwest bay of Wakemika lake is somewhat longer, and passes over ledges of the quartzite-grit. Wakémika lake is a little over three miles in length, and the main portion shows a width of over two miles. The northeastern bay is almost completely separated from the rest of the lake by two opposing ridges of sand which leave a very narrow intervening channel with a gentle current. A considerable bay on the western side of the lake is formed by the projection of a long narrow point or peninsula from the southern shore. The outlet of the lake is into Obabika lake about two miles distant to the southeast, with only two intervening portages. The lake has been excavated for the most part in the massive or upper part of the prevailing banded slates, that here dip N. 75° E., <12°. At one place on the south shore this slate is seen to have developed a perfect cleavage, striking N. 20° W., and dipping west <80°. These slates show the usual transition upward, through a narrow belt or zone of fine-grained greenish feldspathic sandstone, into the coarse-grained light greyish-green arkose, whose massive beds dip to the east < 15°. The eastern shore of Wakemika is composed of the same arkose dipping east <12°. These quartzite-grits on the east side of Wakemika lake, as well as those forming the shores of the western portion of Nonwakaming lake, occupy the upper part of a low synclinal basin, resting conformably upon the slates and slaty greywackés exposed on the southern shores of Wakemika lake and on the eastern side of Nonwakaming lake.

On the west side of the northern bay of Nonwakaming lake the greenish arkose is overlain by a greenish vitreous quartzite, very much sheared and broken, the pressure and fracture planes being coated with brightly glistening scales of yellowish-green sericite. The rock is made up almost wholly of greyish translucent quartz with a lesser proportion of feldspar, some of which has been converted into this hydrous form of muscovite by dynamic action.

The portage from Nonwakaming to Lady Evelyn lake is about twelve chains in length, and is used to avoid a chute and rapids below with a total fall of about twenty-five feet. Lady Evelyn lake (so named in 1888 by Dr. Bell) is known to the Indians as Muskananing (the haunt of the moose). It measures nearly twenty-two miles in length from the portage entering the south end to the rocky obstructed chute which marks the outlet into the Montreal river. The trail reaching the south end shows exposures of greenish slate, containing coarser interlaminated beds of a fine-grained greenish-grey feldspathic sandstone, all having a distinctly bedded character. These partings of greywacké, which vary from a few inches to a foot or even more in thickness, weather to a pale-purplish colour. The strike changes from N. 40° E. to N. 20° E., the various exposures showing marked evidences of considerable tilting and dislocation; the angle of inclination being unusually high, from 38° to 53° in a northwesterly direction. For three miles north of this portage the lake is narrow, being for the most part either obstructed by the loose masses of the prevailing slate or cut up into a number of channels by a series of small islands.

The general trend of the shores, on either side, corresponds rather closely with the strike of the enclosing slates which is N. 20° E., while the dip is in a direction of N. 70° W. < 5° to 10°. The hand specimen collected as typical of the rock occupying this interval is a light greenish-grey fine-grained felsite, of which the jointage planes are coated with hydrated peroxide of iron, while the weathered surface exhibited a pale flesh-red tint. A thin section shows the rock to be composed of orthoclase, quartz and plagioclase, the first-named mineral being the most abundant, while only occasional individuals of plagioclase were noticed. The fragments are very uniform in size and show little or no interstitial matter. They are angular or subangular in outline, frequently interlocking with one another. The section evidently represents a clastic which has suffered little from aqueous abrasion, while subsequent incipient recrystallization has concealed, in many instances, some of the rounded outlines due to the action of water. Irregular scales and plates of chlorite are present, as also a small quantity of iron ore, the abundance of the former giving to the whole rock-mass its decided greenish colour.

About three-quarters of a mile to the south of the large opening that constitutes the main body of the lake these fine-grained feldspathic sandstones or felsites are interrupted by a mass of medium-textured diabase that crosses the lake. Northward it extends along the east shore for a distance of over four miles, being succeeded in this direction by a compact fine-grained greenish greywacké that dips to the west < 10°. On some of the islands lying near this shore a beautifully banded or foliated tufaceous rock was noticed which is intimately associated with the diabase. The latter likewise occupies the southwest shore of the main body of the lake, and also the three large islands in that neighbourhood, as well as a small strip on the western side, the continuity of the mass being broken by the appearance at the coast of an area of very vitreous pinkish or greyish quartzite which dips to the west $< 45^\circ$

For the next succeeding six miles the lake has an average width of over two miles, while it is sometimes as much as three miles. A chain of islands, however, that runs up the centre, as well as a considerable number of islands, both large and small, near the eastern side, conceal much of its true size. The islands in general are low and have a somewhat irregular outline. Those in the southern part are composed of a dark greenish-grey feldspathic sandstone, with a decided slate cleavage, in places corresponding to certain distinctly alternating bands of greyish-green colour, which show a prevailing dip to the east $< 5^\circ$ to 12°. Under the microscope the rock is seen to be a feldspathic sandstone made up of orthoclase, quartz and plagioclase, embedded in an abundant feldspathic matrix, much of which has been decomposed to yellowish-green sericite. This slaty greywacké evidently occurs in a series of low undulating troughs, for on the west shore in the vicinity of perpendicular rocky cliffs a somewhat similar rock is seen dipping N. 70° W. $< 12^\circ$; while still farther north along the same shore the dip is S. 70° E. $< 3^\circ$. A hand specimen of the rock from these cliffs shows a dark greenish-grey rather fine-grained, feldspathic sandstone weathering to a deep brown colour. Under the microscope it is seen to be composed of angular, subangular or rounded grains of quartz, orthoclase and plagioclase, embedded in a groundmass relatively small in quantity, composed of a confused aggregate of minute yellowish-green sericite scales. Occasional fragments of zircon are present and a considerable quantity of iron ore, some of which is ilmenite, as it is seen altering to leucoxene. A large amount of chlorite is present in irregular scales and plates scattered through the rock, and this, together with the sericite and iron ore, gives the rock its prevailing dark greenish-grey colour.

The islands in the northern part of the main body of the lake are composed of more massive and quartzose sandstones, which, as the Obisaga narrows is approached, assumes more closely the appearance and composition of the prevailing arkose.

On the northeast side of the hill, near Wendabin's house, to the northwest of Lady Evelyn lake, the arkose shows massive beds of a pale flesh-red colour. To the eye the rock closely resembles a granite but under the microscope its clastic character is clearly seen, and the texture varying considerably in different parts of the section. Quartz, orthoclase and plagioclase are thickly crowded together and are connected by comparatively little sericitic matrix. This can, however, be seen forming at the expense of the feldspar. There has been some enlargement of the grains by subsequent growth, so that in spite of their clastic character they often interlock with irregular sutures.[*]

To the west of Lady Evelyn lake the country is comparatively flat for a considerable distance, and is composed, for the most part, of a fine-grained, somewhat massive dark, greenish-grey greywacké. This merges gradually upward into the coarse quartzite grit or arkose that constitutes the range of high hills of which Maple mountain (so called by Dr. Bell in 1888), the highest part, is situated almost directly over the western border of the Lake Timiskaming sheet. Specimens of the rock obtained by Dr. Bell, in his ascent of the mountain from the east side, showed the lower portion of this arkose to be a rock not unlike a rather fine-grained granite. This is interlaminated with small greenish bands in which sericite is relatively much more abundantly developed. The rock was examined by Dr. G. H. Williams and shown to be an arkose sandstone, although the grains are mostly angular and often much fractured. They consist of quartz, orthoclase and plagioclase. Neither mica nor chlorite occur in this section, except as a component of the sericitic groundmass, which is somewhat abundant. Stains of ferric hydroxide are plentiful and impart the reddish colour to the rock. At the High pond on Maple mountain the rock is a pale yellowish-grey quartzite, showing distinct, more or less rounded pebbles, which in appearance closely resemble their matrix. Sericite is also abundant, visible to the unaided eye. The microscope shows this rock to be composed of angular, or but slightly rounded grains of granitic quartz, full of fluid inclusions, which are embedded in a ground-mass of sericite and finer quartz fragments. These quartz grains or fragments differ greatly in size, but are under a millimetre in diameter. Feldspar substance is now rare, although once present it seems under the influence of dynamic action to have passed into sericite or muscovite. In a matrix of this character medium sized pebbles are embedded. These differ from the matrix principally in having a more siliceous groundmass, *i.e.*, they are freer from the sericite. They are, however, coated with a membrane of sericite, as is apt to be the case with squeezed conglomerates or grits. The rock shows distinct evidences of the action of pressure, and the development of its mica is probably due to this agency.[*]

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[*] Annual Report Geol. Surv., Can., vol. V. (N.S.), p. 68, F. section No. 25

[*] Annual Report, Geol. Surv. Can., vol. V. (N.S.), p. 63 F.

At the Obisaga narrows the pale greenish-yellow or pale flesh-red arkose forms perpendicular cliffs on the south side, a talus of angular blocks lying at the foot. It occurs in thick, massive, much jointed beds dipping to the southwest < 28°. This rock occupies the shore on both sides of the narrows, extending beyond for a distance of about three-quarters of a mile, where it gives place to and is underlain by the banded slate. There is again a gradual transition downward through a massive and compact slaty greywacké into the readily cleavable and thinly bedded, distinctly banded slate beneath. This succession may be well seen on the south shore of this portion of the lake about three-quarters of a mile west of the Obisaga narrows. The prevailing topography of the country to the eastward undergoes a marked change in outline, and from the narrows, known to the Indians as Obashingwakoka, to the point where the lake turns abruptly to the northward, the shores on either side, especially that to the south, are low and marshy, with only hillocks, points and beaches of yellow sand. The lake is correspondingly shallow, with but a narrow channel among water-weeds.

Before entering the portion of the lake known to the Indians as Ko-ko-ko-wa-bikon, and often referred to at the present time as the Mattawapika, (although this name should rightly be restricted in its application to the immediate vicinity of the outlet of the lake) the water is divided into two channels, separated from one another by an intervening low swampy island. The channels on either side are only about thirty feet in width and both of them show a considerable current, which is likewise sensibly felt in some of the shallower and more obstructive portions to the west. A mass of diabase of dike-like aspect crosses the eastern point of the island, forming the rocky barrier broken through by the waters of the lake. The diabase band, (which is an extension to the northward of the large or main mass of similar rock), is about a quarter of a mile in width, and runs parallel to the lake, forming its immediate western shore-line for the greater part of this last stretch before emptying into the Montreal river. This Western side is, as a rule, steep and precipitous, and the basin occupied by the waters of this part of the lake has been excavated, for the most part, along the line of junction between the diabase and the neighbouring slates exposed on the east side. These slates are banded and rise into rather prominent and steep eminences, the beds dipping to the east at low angles. The contact between the two rocks is well exposed at a point on the west shore about one mile and a half south of the outlet. The diabase is distinctly intrusive through the slates, disturbing and altering them, while veins of quartz containing disseminated sulphides fill the irregular fissures formed during the irruption. At the outlet the slates present beautiful alternating colour-bands of greenish and purplish shades running with and indicating the lines of stratification, the dip being to the southeast < 18°. The outlet shows a series of small rocky islets composed of these slates, between and over the outcropping ledges of which the water pitches in a fine cascade about twenty-five feet in height. The presence of this chute with its rocky environment suggested the name Mattawapika, by which this locality is known to the Indians.

LAKE TIMISKAMING (HAILEYBURY P.O.) TO BAY LAKE (ON MONTREAL RIVER.)

From Haileybury, situated on the west side of Lake Timiskaming, in the township of Bucke, to Bay lake, on the Montreal river, there are two alternative routes. The shorter and more direct, by Sharp and Loon lakes to the northeast end of Portage bay, is, however, that least used, chiefly on account of the greater length of the portages. But apart from this the route offers many advantages over the other. The portage from Haileybury (Matabisataganing) to Sharp lake is by a tolerably good wagon-road, a little over six miles in length, that crosses a somewhat flat country, with, however, a general slope towards Lake Timiskaming. The rock beneath is concealed by what seems to be a good depth of soil, composed chiefly of clay, although in the vicinity of Sharp lake there are occasional outcrops of the greywacké slate. The forest growth in this interval is chiefly remarkable for large specimens of both cedar and poplar, probably the finest noticed in the whole district.

Sharp lake (Agwasabanishing) is comparatively narrow, running north-and-south, and a little over two miles in length. The northern portion presents occasional outcrops of the well banded slate, dipping in a northerly direction at an angle not far removed from the horizontal. On the west shore of the lake, in close proximity to the slate exposures at the first narrows south of the portage, and extending for a distance of a quarter of a mile, are outcrops of a medium-textured greenish and greenish-grey diabase, which evidently forms the extension in this direction of the large mass that runs towards Lake Timiskaming and the Montreal river. The southern half of Sharp lake has low sloping shores, which are for the most part densely wooded and show no rock exposures of any kind.

The portage to Loon lake starts from the bay on the west side near the southern end of the lake, and is nearly two miles in length, passing through a level country underlain by coarse sand and gravel. Loon lake itself is only about three-quarters of a mile in length, of a [illegible]lely oval outline, exhibiting low swampy shores, composed for the most part of coarse sand with no outcrops of rock. The Indians call this lake Ka-mang-onsiwing. The portage from Loon lake to Bay

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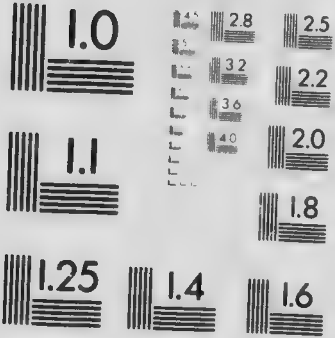

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lake is about two miles and half in length, and also runs through a comparatively level stretch of country, apparently underlain by diabase. A portage between a quarter and half a mile in length separates Sharp lake from Mud lake (Ka-wabijish-keewaga) into which it drains. This is somewhat larger in size than Sharp lake, though very shallow, and has the same general direction. The shores of Mud lake are low, and there is not a single rock exposure throughout the whole extent of the shore-line, which consists of coarse sand and rounded boulders. The portage from Mud lake to the Montreal river is a little short of half a mile, running through a sandy flat between hills of diabase, which rock occasionally outcrops close to the path. To the north and east of Mud lake there are several small lakes, most of which drain northeastwards towards Farr creek. Bass lake is a beautifully clear and limpid sheet of water, and is apparently fed by springs. This lake is almost on the same level with Mud lake, into which it empties, and from which it is separated by a short portage.

The portage to Clear lake, at the head of the west branch of Farr creek, starts from the north end of Mud lake, about an eighth of a mile southeast of that going to Sharp lake, and is over three-quarters of a mile in length. It passes through woods composed chiefly of poplar and soft maple, and over ridges of greenish diabase or gabbro, the summit rising about two hundred feet above Mud lake. Clear lake, as well as the much larger one to the northeast, into which it empties, and which on account of its numerous islands and bays is called Sassaganaga lake, are surrounded on all sides by well wooded ridges composed of diabase and gabbro. Fragments of the banded slate were noticed embedded in the eruptive. Both these lakes and the stream which forms this outlet constitute portions of a route to Lake Timiskaming which is now practically abandoned.

LAKE TIMAGAMI.

This name is of Chippewa derivation, meaning "deep water." Other names, Temagaming, Temagamang and Tamagamingue, often applied to it, are different methods of spelling the same word, while the additional ending "inw" or "ingue" is simply a locative affix denoting "at" or "towards the place of."

In shape the lake presents long and often branching arms reaching out in various directions from a somewhat stunted body. The main part of the lake, which occupies an approximately central position with regard to the different large bays, covers roughly an area of about twenty-five square miles, although the greater portion of this space is dotted with islands, some of which are of large size. The water superficies of the various large arms represent an additional seventy-five square miles, making a total of one hundred square miles. It has a general north-and- south direction, and its greatest length, from the southern end of the southwest arm to the northern extremity of Whitefish bay, is twenty-eight miles and a half in a straight line, although the most direct canoe channel between these two points measures thirty miles. In width, from the western shore to the main body of the lake to the portage running to the Caribou Lake portage, it is sixteen and a half miles in a direct line. The most important of the many bays that form so large a part of this lake, is the Northeast arm, extending from Point Matagama to the Caribou Lake portage, a little over twelve miles, in a direction about N. 60° E., and varying in width from half a mile to a mile. To the south of this, Muddy Water, Cross and Portage bays indent the eastern shore-line, the first-mentioned being about four miles long and half a mile wide. The South arm lies almost directly north-and-south, and is about seven miles in length, from a mile to over two miles in width. The southern and southeastern shores present a series of smaller bays, the largest of which affords an exit to the chief outlet of the lake, a steep rapid known as the Timagami chute, separating these waters from those of Cross lake. The Southwest arm is almost completely cut off from the main lake by Narrows island. The connecting channel to the southeast of this island is very narrow and crooked, while that between the island and the western mainland has a width of a little over an eighth of a mile. From this narrows the bay extends for about three miles, gradually bending around to the south, which trend is maintained for a little over six miles farther, when it branches into two smaller bays, one running to the southwest and the other to the southeast for a distance of about two miles in each case. The width is very variable, in some cases the shores being separated by a distance of over two miles, while in the more contracted portions they usually approach within a quarter or a half a mile of one another.

To the north, the largest extension has been called the North arm, from its general trend. Nearly eight miles north of the Hudson's Bay Company's post this arm is divided into two subsidiary bays, the eastern one being known as Ferguson bay, running towards the inlet from Annima-Nipissing lake, a distance of nearly five miles farther: while the western extension runs a little west of north for about eight miles, being again subdivided at the upper end into two parts known as Whitefish bay and Sharp Rock inlet. The latter portion is almost completely separated from the rest of the lake by Deer and Beaver islands, having narrow and crooked channels at either extremity, in which more or less current is usually discernible, especially after violent winds from the south.

Between the North and Northwest arms there are several minor indentations, known as Ko-ko-ko, Young Loon and Spawning bays. Of these the first mentioned is the largest, running in a direction a little east of north for a distance of about four miles, and receiving at its head the waters of a rather large lake bearing the same name. The Northwest arm (Wuskigama) runs a little west of north, with an average width of over half a mile, for a distance of a little over four miles from Naipaga point, when it changes abruptly to the west, which general course is maintained, with slight deviations, for a further distance of nearly three miles and half.

Like other lakes of the Archæan region this is characterized by great irregularity of its shore-line and by the vast number of islands with which it is filled. These islands vary in size from mere rocks to some which are several square miles in area and complex in form. As shown by the detailed survey of the lake there are over thirteen hundred of these islands scattered over the surface, the main body of the lake, especially, containing a large number.

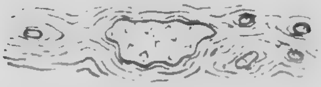
The most important factors that have determined the distribution of land and water are the strike of the foliation or planes of pressure-cleavage and the unequal resistance offered during the progress of erosion by the different varieties of the surrounding rocks. The various bays or arms have been excavated for the most part in the slaty bands, in a direction corresponding with the strike of the foliation; while the shore-lines frequently and for long distances are composed of the hard and unyielding massive diabases or gabbro. As a rule the banks of the lake are high and rocky in many places, especially where the diabasic rocks prevail, rising in cliffs from a hundred to two hundred feet in height. Marshy tracts are few and small, and with the exception of occasional reefs the water is comparatively deep to within a very few feet of the shore. Sandy or shingle beaches are, as a rule, rather rare and of small extent, although at the northern end of the lake, forming the northern shore of Sandy inlet (Kawaminashing) there is a fine sandy shore.

The deepest of a few soundings made, at a point within about thirty chains of the western shore of the main body of the lake, was 167 feet, while another within about half this distance from the same shore showed 127 feet. About mid-channel between Bear island and the group of islands opposite to the west t[illegible]th varies from seventy-five to eighty-five feet. Several soun[illegible] taken at various places about the central part of the channel of the Northeast arm clearly showed the existence of a deep and practically unobstructed navigable channel to within a short distance of the portage to Caribou lake. The greatest depth was found about [illegible] mile southwest of Broom island, 120 feet, while in the centre of the large open space about three miles and a half from the Caribou Lake portage the depth is only ninety-five feet. At the several contracted places along the course of the channel the water is much shallower, the depth opposit the mouth of the Tétapaga lake being only fifty-one feet, while in the narrows, about a mile and a half from the portage, the depth is only twenty-nine feet. The water of the lake is pure and clear and of a light sea-green tint, while the fish, chiefly trout, whitefish, bass, pickerel, pike and ling, are noted for their size and quality.

The clastic rocks exposed on the shores of this lake include at the base the usual and widespread breccia-conglomerate. This rock has already been described, and here presents no unusual features requiring special mention. Here, as elsewhere throughout the region, it passes upward through a massive dark-greenish greywacké or feldspathic sandstone, comparatively free from the larger fragments or pebbles, into a branded slate which is the highest member of the Huronian noticed in the tract of country immediately bordering this lake. Along the Northeast arm the prevailing rock is a light greenish-grey sericite schist containing a great deal of quartz in the form of small lenticular patches and veins running parallel to the foliation. Interlaminated with these hydromica schists are rudely oval patches or masses of a light greenish-grey siliceous dolomite. The quartzose impurities are arranged in narrow vein-like forms which reticulate in all directions through the mass, so that when subject to ordinary weathering processes these stand out in relief, leaving irregular hollow interruptions composed of the softer and more easily distinguished material. One of these masses occurs on the smaller point to the east of the outlet from Hay lake on the north shore, while several were noticed along the lower portion of the outlet from Tétapaga lake as well as at several points along the shore in this neighbourhood. A large mass occurs on some islands a little over half a mile west of the portage into Caribou lake. The sericite schist curves around these ovoid masses of impure dolomite, the latter having been but little deformed by the pressure which has tilted and altered the schists.

These hydromica schists or slates have evidently resulted from the shearing and decomposition of the Huronian slates, due to the close proximity of the two large masses of granite that occur to the north and south of this bay. It seems probable that these two masses of granite are united at a short distance below the present surface, and that the schists, therefore, occupy a comparatively shallow and narrow trough of highly inclined strata which have sagged down somewhat into the originally plastic mass beneath. This supposition best explains the abundance of the quartz veins and masses of pegmatitic or secondary origin, as well as the extreme but uniform alteration of the clastic material, indicating the former presence of an abundant supply of super-saturated and heated siliceous waters and vapours connected with the intrusion of the granite. On Ko-ko-ko bay, likewise, the clastic rocks have in many places undergone extensive alteration, and the pebbles and fragments of the prevailing breccia-conglomerate are embedded in a highly squeezed sericitic or chloritic matrix, which has a flow-like arrangement round the inclusions, caused by the greater hardness of these offering more effectual resistence to the pressure to which the softer matrix has yielded.

Fig. 6.



PEBBLES IN SERICITE SCHIST, KO-KO-KO BAY.

Throughout the whole of the southern part of the lake the numerous and wide exposures, almost without exception, show the granitic and diabasic pebbles and fragments characteristic of the basal breccia-conglomerate; but in some places the massive greywacké occurring above is present, while in occasional localities at the northwest point of High Rock island and the northwestern part of Cross bay the still higher banded slates rise into hills of more than a hundred feet.

The most distinct and persistent structural feature which obtains in the more massive forms of the greywacké and breccia-conglomerate is a pressure-foliation or cleavage. In most places there is little or no sign of stratification, especially in the basal beds, the pebbles and fragments being irregularly distributed in a massive and compact matrix, but the colour bands of the overlying slates are a certain criterion of sedimentation, and these show plainly that the various clastic rocks lie in low, broad undulating folds, dipping for the most part at gentle angles. The development of the foliation seems to have been determined by the pressure exerted during the intrusion of the large masses of irruptive material with which the clastic rocks are so intimately and so frequently associated. The breccia-conglomerate greywacké and banded slates are very evidently graded forms of the same rock, differing only in their relative degrees of coarseness. In origin they plainly represent pyroclastic material, and may be connected generally with the irruption of the massive plutonic rocks, although the clastic rocks have very evidently been disturbed and altered to a certain extent during the progress of their irruption. Such structural relationship is not, however, inconsistent with known facts of contemporaneous volcanic action, the associated volcanic ejectamenta being frequently pierced and altered by dikes and masses of the parent plutonic.

The irruptive rocks present on the lake comprise diabase, gabbro and granite. The diabase and gabbro are usually intimately associated in the same mass, differing only in their structure, which is sometimes macroscopically apparent, but, as a rule, only under the microscope. In composition they are made up chiefly of plagioclase and augite, the latter usually showing incipient alteration to green trichroic hornblende, while occasionally, especially in the vicinity of certain small shrinkage-cavities, the reddish-brown augite is completely decomposed to hornblende that has assumed the actinolitic habit. Usually biotite is present, sometimes in considerable quantity and some allotriomorphic quartz, filling in the interspaces between the other constituents. Ilmenite, showing the characteristic alteration to leucoxene, pyrite, chalcopyrite and pyrrhotite, may also be noticed. A portion of the northeast shore of the main body of the lake presents exposures of coarse flesh-red granitite, forming the extension in this direction of the mass which covers so large an area to the north-east. The rock is exceedingly coarse and massive, often porphyritic, the phenocrysts being mostly Carlsbad twins of orthoclase, often from one to two inches in diameter. The biotite, originally present in small quantity, has been almost wholly converted to chlorite. The whole mass is intersected by numerous, often large, dikes of pegmatite and fine-grained felsite.

In the area immediately surrounding Lake Timagami are several small lakes, some of which are worthy of brief description. The largest of these, Obabika (Rocky Narrows) lake is about fifteen miles long, with an average width of over three-quarters of a mile. The inlet, and the outlet, are situated within three-quarters of a mile from one another, on the west side, near the northern end of the lake. Two short portages, nearly half-way down the lake on the east side, afford an entrance through a small lake into the Northwest arm of Lake Timagami. A short portage separates this lake also from Wawiagania or Round lake, which extends beyond the western boundary of the map, constituting an important link in a canoe-route towards the Sturgeon rapids, and thence to Wanapitei lake. In the northern portion of Obabika lake the rock exposed along its somewhat flat shores is the banded green slate, the light and dark-greenish bands indicative of the bedding dipping E.N.E. < 12° to 15°. Diabase comes out on the eastern shore to the south of the small bay on the route to Lake Timagami, while the breccia-conglomerate in very massive beds outcrops all along the eastern shore in the southern part, and the overlying evenly banded slates at one point on the western shore from nearly vertical cliffs of considerable altitude, with a northwesterly dip < 3°.

The immediate shores of Round lake are low, that on the south side exhibiting a good many low hummocks of slate, with intervening swampy stretches. The western shore to the north of the outlet is formed by comparatively high cliffs, the lower portion of which, up to a height of about fifteen feet above the water, is composed of a green, well banded slate, dipping at a low angle (about 3°) to the west, while superimposed upon this, probably as a sill, is a massive greenish diabase containing abundantly disseminated pyrite. The northern shores show only one exposure of slate, the intervening spaces being low and swampy.

Gull lake (Gyasgosenda), to the west of the main body of Lake Timagami, forms a part of the most direct canoe-route across country to Wanapitei lake. Three different routes may be taken from Timagami to Gull lake. The most northerly is made up of two portages and an intervening small lake; the first portage leaving a small bay on the west side of Lake Timagami, a short distance south of Naipaga point at the entrance of the Northwest arm, while the second portage debouches on the extreme northern end of Gull lake. A second route, and the one most frequently used, consists of a single long portage, which goes up a gully on the west shore of the lake directly opposite the Hudson's Bay Co.'s post, while a third leaves the Southwest arm about two miles southwest of the narrows, and passing through two lakes comes out on the east side of the southern half of Gull lake. The canoe-route thence to the Sturgeon river has seven portages, none of which are of any great length, while the lakes encountered, Turtle, Manito-peepagee and Wawiashkashing, are all of them rather large and important.

On the northwest side of Gull lake the rock is the greywacké slate, while the eastern shore, as well as the southern part of the lake, show outcrops of the massive greenstone ([illegible] gabbro). The contact between this irruptive diabase and [illegible] ated slates, on the most northerly of the canoe-routes en[illegible] lake, comes in near the southwest end of the first portage [illegible] Timagami, the dark greenish-grey feldspathic slates in conjunction dipping S. 70° W. < 65°.

From this point the line of demarcation curves around to the southwest, striking the east shore of Gull lake about three-quarters of a mile from the north end. Crossing Gull lake, the islands in this portion of which are composed of slate, it leaves the bay, running to the southwest immediately north of the narrows. To the south, the contact between the greenish feldspathic sandstone and breccia-conglomerate leaving the west shore of Lake Timagami, about three-quarters of a mile south of the narrows at the entrance of the Southwest arm, crosses the first portage on the most southerly of the three routes to Gull lake. Thence, with a southwesterly strike, it cuts across the southern ends of Gull and Turtle lakes, and runs to the east of Manito-peepagee lake, and parallel to its general trend as far as its southern extremity. Here it turns abruptly to the west, crossing the southern end of this lake, and the small lake on the route immediately to the west. The slates and feldspathic sandstone in conjunction with this greenstone are all hardened and otherwise altered in the immediate vicinity of the contact, while the pressure-cleavage which is the only visible structural feature conforms with the line of outcrop of the diabase.

Ko-ko-ko, or Night Owl lake, enters the northern end of a narrow arm or inlet which bears the same designation, running in a northerly direction from the main body of Lake Timagami. The shores exhibit excellent exposures of the breccia-conglomerate on the east side, with which rock is associated an overlying compact feldspathic sandstone. These are penetrated by a massive intrusive greenstone, chiefly diabase in composition and structure, which occurs in a large mass coming out on the northwest side of the lake.

Young Loon and Spawning lakes enter smaller bays off the east side of the main body of Lake Timagami, the latter, together with McLaren, Commanda and Hay lakes, forming a canoe-route, which, with short intervening portages affords a means of communication between this portion of the lake and the Northeast arm, near Broom island. With the exception of Hay lake all are surrounded by hills of a coarsely crystalline flesh-red granitite, composed chiefly of flesh-red feldspar, greyish-white quartz and a sparing quantity of chloritized biotite. Occasional exposures are rather fine-grained, and contain proportionately a greater amount of the coloured constituents, while, on the other hand, the coarser-grained material is almost entirely free from the bisilicates. At one point near the south end of Young Loon lake a dike of dark-greenish compact material was seen cutting the granite and running N. 28° E. The contact between the mass of granitite and the sericitic schists exposed to the south on Hay lake and the Northeast arm of Lake Timagami crosses about half way over the portage between Commanda and Hay lakes.

Tétapaga creek, which enters the Northeast arm of Lake Timagami a little over two miles east of Broom island, serves to drain Tétapaga and Vermilion lakes, which, together with two small beaver-ponds and Kaniehee-kinikisinik lake beyond, form a short and direct canoe-route to Net lake. From the east end of Tétapaga lake a portage runs to Turtle lake, which empties into a bay on the southwest side near the lower end of Net lake, and a short carry over some ledges of serisite-schist, from the south side of Turtle lake, affords an entrance to the Northeast arm of Lake Timagami to the north Ferguson Mine point. Tétapaga creek, which runs in a southwester direction, is navigable for canoes for a distance of over a mile from the lake, and a portage of less than half a mile on the southeast side of the stream is all that intervenes before Tétapaga lake is reached. The rock exposed along the river is the dark greenish-grey and gree ish hydromica and chloritic schists, striking from N. 50° E. to N. 60° E., and dipping to the northeast < 60°. These schists are inte foliated with occasional large oval patches or areas of a rusty weath ing silicecus dolomite.

On Tétapaga lake the rock is, for the most part, a light greeni grey sericite-schist, nearly vertical in attitude, and with a strik N. 78° E. On Vermilion lake the rock is very similar in charact has an average strike of N. 57° E., dipping to the south 80°; while on the southeast shore a quartzose slate contains b of red hematitic matter interlaminated with others of finely gra lar magnetite. In places the rock is associated with chlorite, and greatly decomposed, showing large quantities of pyrite and pyrrho the whole striking N. 70° E. and dipping southeast < 75°. On portage running northwards from the beaver-pond that li northeast of Vermilion lake the rock exposed is a light gre grey sericitic schist, striking from N. 44° E. to N. 59° E., and dipping southeast < 70°.

APPENDIX I.

LIST OF ELEVATIONS.

The following elevations were obtained from a careful compilation of the profiles of the Canadian Pacific railway, the Northern and Northwestern Division of the Grand Trunk railway, the location survey of the Nipissing and James Bay railway, together with a list published in 1860, by Thomas C. Clarke, C.E., in a report on the surveys of the Ottawa Ship canal. These were corrected by a comparison with the recently perfected levels of the United States Lake Survey, as published by Mr. L. Y. Schermerhorn in the *American Journal of Science*, April, 1887.

The heights of the various lakes on the Mattawa river are from a list compiled by Mr. James White, Geographer to the Geological Survey of Canada.*

Elevations marked thus (*) have been deduced from actual levelling, while the others have been determined by means of the aneroid barometer checked at frequent intervals.

All heights are in feet above mean tide water at Quebec.

Miles from Montreal.		Height in Feet.
	I. Elevations on Canadian Pacific railway, Ma[illegible]	
318	Mattawa	*524
324	Calvin	*696
330 1	Eau Claire	*591
336 9	Rutherglen	*837
343 9	Bonfield	*782
347 9	Nasbonsing	*785
357 5	Thorncliffe	*699
360	Nipissing Junction	*674 6
363 5	North Bay	*659
373 5	Beaucage	*673
378	Meadowside	*661
386 8	Sturgeon Falls	*685
389 7	Cache Bay	*652
397 4	Verner	*669
406	Warren	*689

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* See Trans. Roy. Soc. Can., 2nd Series, vol. 1., Sec. VI., pp. 188-189.

Miles from Junction		Height in Feet
	[illegible]	
	Junction with Main line	[illegible]
11.25	Snake Creek siding	[illegible]
24.30	Lumsden station and siding	[illegible]
	Kipawa Junction	[illegible]
37.95	Gordon Creek station	[illegible]
38.67	Lumsden Mills siding	*801
	Bridge over Long Lake	[illegible]
	Bridge over [illegible]	[illegible]
[illegible].77	Kipawa station and siding	[illegible]
	Kipawa Lake Inn	[illegible]

Miles from Toronto		Height in Feet
	[illegible]	
216.9	Crossing with the Nipissing and [illegible]	[illegible]
219.6	[illegible]	[illegible]
223.5	[illegible]	[illegible]

		High Water	Mean Level	Low Water
[illegible]		Feet	Feet	Feet
Ottawa River junction with Mattawa river	(1859)	*509.5		[illegible]
	1890	[illegible]		
	1891	*506		
	1892	*503		
	1893	*507.5		
foot of La Cave rapids		*509.5		[illegible]
head of La Cave rapids		*519		[illegible]
foot of Les Erables rapids		*520.31		[illegible]
head of Les Erables rapids		*532.63		[illegible]
foot of Mountain rapids		*533.13		[illegible]
head of Mountain rapids		*540.13		[illegible]
foot of Seven League lake		*540.13		[illegible]
head of Seven League lake		*542.63		[illegible]
foot of Long Sault rapids		*542.63		[illegible]
head of Long Sault rapids		*591.63		[illegible]
head of Long Sault rapids (1887)		*591		*572
head of Long Sault rapids (1894)		*591		[illegible]
Lake Timiskaming below Presqu'ile		*591		[illegible]
above Presqu'ile		*591		*577
below Opimika narrows		*591		*577
above Opimika narrows		*591.8		[illegible]
below Old Fort narrows		*591.8		[illegible]
above Old Fort narrows		*592		*578
Lac des Quinze			845	

Miles from Montreal	*Levels on Mattawa river*	High Water.	Low Water.
		feet	feet
308 00	Mouth of Mattawa river	*500·5	
310 16	Foot of Plein Chant rapid and chute		[illegible]·9
310 80	Head of lac Plein Chant		[illegible]·6
316 25	Foot of Des Epines rapids		*517·5
316 40	Head of Des Epines rapids		*517·7
316 8[illegible]	Foot of Rapide de la Rose		*523·3
317 00	Head of Rapide de la Rose		*523·5
317 20	Foot of Rapide des Rochers		*529·1
318 40	Head of Rapide des Rochers		*530·5
319 00	Foot of Rapides des Aiguilles		*535·3
319 01	Head of Rapides des Aiguilles		*535·4
321 65	Foot of Chute de Paresseux		*535·8
321 85	Head of Chute de Paresseux		*535·8
322 20	Foot of Little Paresseux rapids		*569·6
322 35	Head of Little Paresseux rapids		*569·6
323 48	Foot of Lake Pimisi (Eel lake)		*577·8
324 53	Foot of Talon chute		*590·6
324 71	Head of Talon chute		*590·6
325 18	Rapid below Lake Talon		*633·3
325 33	Foot of Lake Talon		*633·3
to		*639·3	639·2
332 34	Head of Lake Talon		
336 08	Foot of Turtle lake	*665·9	*664·1
339 36 to 347 79	Trout lake	*667·8	*665
351 08	Lake Nipissing (East shore)	*647·8	*640·5

Levels on Sturgeon river	High Water	Mean Level.	Low Water.
	feet.	feet.	feet.
Lake Nipissing	*647·8		640·5
Sturgeon river, below Sturgeon Falls		645	
above Sturgeon Falls		676	
below S[illegible] falls		680	
above S[illegible] falls		696	
below R[illegible]s		697	
above R[illegible]		703	
below Smoky falls		704	
above Smoky falls			
mouth of Tomiko river	*732·14		*722·14
mouth of Pike river	*736·51		*723·51
mouth of Snake creek	*740·60		*725
mouth of Timagami river	*748		*730
at mouth of Maskinonge river	*752		*735
at mouth of Wawashkashing creek	*795		*785
First lake on Maskinonge river		815	811
Second lake		813	
Third lake (Murray lake)		814	
Fourth lake		815	
Maskinonge wagaming lake		826	
Small lake (on Kookagaming creek		836	
		844	
		856	
		864	

	High Water.	Mean Level.	Low Water.
6. Levels on Sturgeon river—Cont.	feet.	feet.	feet.
Kookaganing lake		882	
McLaren river (at foot of portage from lake)		872	
Mattagomashing lake		871	
Small lake flowing into Wanapitei		859	
Wanapitei lake		858	
7. Levels on Timagami river.			
Mouth of Timagami river	*752		*735
Island lake		889	
Red Cedar lake		900	
Head of Swift Current		903	
Head of Sand-bar rapid		919	
Head of Burnt Portage rapid		930	
Head of rapid		936	
Head of Log-jam rapid		951	
Head of Twin rapids		957	
Head of Flat rapid		958	
Lake Cross		959	
Timagami lake		964	
8. Levels on Marten creek.			
Red Cedar lake		900	
Marten creek, above rapid		903	
" " Swift Current		904	
" " rapid		909	
" " Swift Current		909	
" " rapid		911	
" " "		914	
" " "		919	
" "		926	
" " falls		935	
" " rapids		936	
Marten lake		936	
Small lake (on lot 6, con. v, Gladman)		990	
" (on lot 5, con. iv, Gladman)		990	
Wicksteed lake		941	
Forks of Boices and Mackenzie Lake outlets		944	
Boices lake		956	
Lower Red Water lake		1003	
Upper Red Water lake		1004	
Mackenzie lake		956	
Simpson lake		966	
Expectation lake		968	
Desperation lake		883	
Salvation lake		1008	
Breadalbane lake		986	
McDiarmid lake		992	
Fanny lake		994	
Bush lake		981	
9. Levels on Tomiko river			
Mouth of the Tomiko river	*736.51		*723.51
Tomiko lake		795	

	High Water.	Mean Level.	Low Water.
9. Levels on Tomiko river.—Cont	feet.	feet.	feet.
Lake Chebogomog		798	
Cameron lake		803	
Tilden lake		928	
Lake lots 6 and 7, con. iii, Gladman		930	
Lake lot 7, cons. iii and iv, Gladman		932	
Kaotisinimigouang lake		948	
Poplar lake		949	
South Spruce lake		978	
North Spruce lake		978	
10. Levels on Ottertail river.			
Mouth of Ottertail river on Lake Timiskaming	*591·8		*577·8
White-beaver lake (Wabaunk lake)		841	
Ruth lake		991	
Beaver pond (head of river)		991	

	Height.	High Water.	Mean Level.	Low Water.
11. Levels on Matabitchouan river.	feet.	feet.	feet.	feet.
Lake Timiskaming, at mouth of river		*591·8		*577·8
Summit of Matabitchouan portage	927			
Beaver mountain (King of Beavers)	1247			
First Bass lake			858	
Second Bass lake			858·5	
Third Bass lake			859	
Fourth Bass lake			864	
Rabbit lake			*938	
White-bear lake			*942	
Crooked or Snake Island lake			*953	
Net lake			965	
Thieving-bear lake			975	
Small lake			981	
Small pond			991	
Lake			1006	
Marshy stretch on river			1022	
Small pond			1027	
Mountain lake (head of Matabitchouan river)			1029	
Ferguson lake			971	
Duncan lake			971	
Petrout lake			996	
Lily lake			1001	
Peeshabo lake			1005	
Bogie lake			1007	
Granite lake			1006	
James lake			1023	
Waibikaginaising or Rib lake			1013	
Cliff lake			1048	
Summit lake			1168	
Beaver meadow			1158	
Friday lake			1103	
Wilson lake			1173	

	High Water.	Mean Level.	Low Water.
12. Levels on Macdonald creek.	feet.	feet.	feet.
Mouth of Creek on 4th Bass lake, Matabitchouan river.	......	864	
Cooper or Macdonald lake	......	914	
Small lake	......	924	
Glasford lake	......	927	
Small lake	......	927	
Moxam lake	......	933.5	
Burwash lake	......	934	
Ross lake	......	936	
Rabbit lake, Southeast bay	......	*938	
13. Levels on the Montreal river.			
Mouth of Montreal river (Lake Timiskaming)	*591.8	......	*577.8
Farm house (Lumber depot) on Long portage, 860 feet	......	......	
Summit of Portage, 880 feet	......	......	
Montreal river at head of Long portage (3 miles fr. mouth)	......	736	
" above First rapid	......	748	
" " Second rapid	......	760	
" " Third rapid	......	770	
" foot of Fountain falls	......	773	
" head of Fountain falls	......	792	
" " Ragged chute	......	823	
" above Fourth rapid	......	830	
" " Fifth rapid	......	836	
" " Hound chute	......	861	
" at portage to Mud lake	......	869	
" at foot of Sixth rapid	......	871	
" at head of Sixth rapid	......	878	
" " Seventh rapid	......	882	
" at foot of Eighth rapid	......	883	
" at head of Eighth rapid	......	890	
" Bay lake	......	890	
" at mouth of Timagami branch	......	903	
Indian lake	......	901	
Round lake (Mountain lake)	......	911	
14. Levels on Route, Timagami to Red Cedar lake.			
Lake Timagami	......	964	
Olier lake	......	984	
Denedus lake	......	1022	
Wasacsinagama lake	......	1025	
Beaver meadow	......	1035	
Green lake	......	1046	
Brophy lake	......	1056	
Ingall lake	......	1050	
Jumping Caribou lake	......	1048	
Upper Twin lake	......	993	
Lower Twin lake	......	977	
Mann lake	......	975	
Norris lake	......	935	
Hanging-stone lake	......	918.9	
Red Cedar lake	......	900	
15. Levels of Various lakes.			
Pike lake (Lac aux Brochets) on Gordon creek	......	......	*794
Long lake, on Gordon creek	......	......	*820.5

	High Water.	Mean Level.	Low Water.
15. Levels of Various lakes.—Cont.	feet.	feet.	feet.
"T" lake	*856		*849.5
Lake Kipawa	*880		*870.70
Summit of portage between Kipawa and Douglas		957	
Douglas lake		852	
Little Obashing lake		832	
Forest lake		862	
Birch lake		862	
Devil lake		834	
Bastien lake		877	
Thompson or McConnell lake		874	
David lake		869	
Obashing lake		822	
Summit of Road between Obashing lake and Ottawa river, 942 feet			
Small lake at head of Snake creek on old Winter road		847	
Second lake on Snake creek on old Winter road		827	
Long lake on White creek		852	
White lake at head of White creek		872	
White Beaver lake (East of McMartins point)		883	
First lake on Indian portage-route to Kipawa		883	
Emerald lake		1009	
Small lake at head of Opimika creek		1167	
Sharp lake		905	
Mud lake		900	
Bay lake		890	
Lady Evelyn lake		930	
Nonwakaming lake		955	
Big Whitefish lake		1010	
Lynx lake		1025	
Cole lake		1045	
Turner lake		1057	
Annima-Nipissing lake		1070	
Breeches lakes		1085	
Mannajigaina lake		1075	
Trout lake		857	
Wakmika lake		935	
Obabika lake		932	
Wawiagama lake		917	
Small lake south of Nonwakaming lake		961	
" between Nonwakaming and Wakmika lake		960	
Bear lake		997	
Angus lake		1051	
Free Portage lake		966	
Rankin lake		976	
Miller lake		977	
Kettle lake		1015	
Lake Nasbonsing	*781	*776	

APPENDIX IV.

ON SOME CAMBRO-SILURIAN AND SILURIAN FOSSILS FROM LAKE TIMISKAMING, LAKE NIPISSING AND MATTAWA OUTLIERS.

By H. M. AMI.

LAKE TIMISKAMING.

CAMBRO-SILURIAN (ORDOVICIAN.)

In describing the Niagara formation on Lake Timiskaming Sir Wm. E. Logan remarks:—*"There are found lying on the Niagara limestone loose angular fragments of dolomite resembling that of the Birds Eye and Black River formation of Lacloche and Lake Nipissing, and holding *Strophomena alternata*, species of *Maclurea* like *M. magna, and M. atlantica, Orthoceras anceps*, and *O. proteiforme*." He adds:—'The source of these fragments has not yet been ascertained.'

From the assemblage of forms identified by the late E. Billings and recorded in Sir Wm. Logan's remarks above, there is no doubt that there must be represented somewhere in the vicinity of Lake Timiskaming one Cambro-Silurian horizon at least, i.e., the Birds Eye and Black River formation. It remains still to be ascertained whether any older members of the Cambro-Silurian occur under the somewhat extensively developed Silurian rocks. The Black River formation of the district is known so far only by loose, but angular and apparently not far-travelled pieces of limestone. It can scarcely be conjectured that these pieces of limestone came from any other district than the Timiskaming area, as there are no outcrops of rocks of Black River age known in the region to the north of Lake Timiskaming.

SILURIAN.

Silurian fossils abound on Lake Timiskaming and are well preserved in the several outliers. From the 'Head of Lake Timiskaming' the first collections were made by Sir Wm. E. Logan in 1845. These are recorded by Mr. E. Billings and enumerated on the page already referred to. The occurrence [illegible] *ysites catenularia*, and of

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*Geology of Canada, (1863,) p. 335

Favosites gothlandica, was sufficient evidence to enable Mr. Billings to definitely state that the rocks from which they came were Silurian. Some thirteen species were determined at the time.

Notes on certain species.

The collections made by Dr. Bell and Mr. Barlow are very extensive. One of the most prominent and characteristic features in the fauna represented is the prevalence of corals, not less than seventeen species of which have been recognized by Mr. Lambe. Of these corals, the 'chain-coral' (*Halysites catenularia*) and the 'honey-comb coral' (*Favosites gothlandica*) occur in great profusion. They are preserved for the most part in a silicified condition—not the best by any means for study—in a manner much resembling that in which the fossils of the Black River formation are found at Paquette rapids on the Ottawa river below Pembroke, Ontario.

Few of the higher forms of organisms characteristic of the Silurian period are found directly associated with the corals, but *Clathrodictyon vesiculosum,* Nicholson and Murie, one of the Hydromedusæ, does occur very abundantly and is associated intimately with the corals.

The Crinoidea are very rare; only three species having been recorded as yet from this basin.

The Annelids are represented by a single specimen of a Conodont, whilst the Bryozoa, so abundant in certain rocks of the Niagara and Clinton formations in the province of Ontario and in New York state, are rather sparsely distributed in the Lake Timiskaming rocks.

Brachiopoda occur in certain bands by themselves and at times are very abundant. Such is the case with *Atrypa reticularis,* Linnæus. *Pentamerus oblongus,* Sowerby, a form characteristic of the Wenlock in England and of the Niagara of the Interior Continental plateau of Palæozoic rocks in North America, occurs in vast numbers in a certain band of yellowish-grey limestone on Mann island.

The Lamellibranchiata or Pelecypoda are very rare, only two genera having been noticed from all the collections.

The Cephalopoda are well represented, and of these *Discosorus conoideus,* Hall, is the most conspicuous and interesting—although the Orthoceratites include amongst others:—*Actinoceras vertebratum,* Hall, (said to be identical with *Actinoceras backi,* Stokes, described from the Artic regions of North America) and several other forms peculiar to the Niagara formation of New York and Ontario.

The Trilobites are few. Two forms recorded may be the North

American representatives of the two European species *Calymene blumenbachii*, Brongniart; and *Encrinurus punctatus*, Wahlenberg. The Ostracoda are likewise very rare. A few fragments of Algæ occur in Mr. Barlow's collections and appear to represent two species previously recorded from rocks of similar age in New York state.

The whole fauna comprises eighty-eight species, representing fifty-nine genera. These species are for the most part forms referable to the Niagara formation, although a number of forms, such as the corals and brachiopods, are also well known to occur in rocks assigned to the horizon of the Clinton formation.

There are specimens of *Favosites gothlandica* from Mr. Barlow's collection of 1894 which measure a little more than fifteen inches in diameter or over four feet in circumference. The mode of growth of these Favosites is similar to that described by Prof. G. H. Girty in the case of *Favosites forbesi* var. *occidentalis*, and very perfect examples of such large dimensions are not rare on Mann island. They exceed in size and perfection of structure the large masses of Favosites from the Hamilton formation of Thedford, Ont. Large and small specimens of this species occur together, and such is the case also with specimens of the *Clathrodictyon vesiculosum*, Nicholson and Murie. This is the species which was described by Billings as *Stromatopora concentrica* of Goldfuss. The largest specimen met with measures fourteen, by ten, by eight inches.

Syringopora verticillata, Goldfuss, was described from specimens which came from Lake Huron. It is found in tolerable abundance in the Silurian of Lake Timiskaming. This fact, together with the occurrence of several other species which are common to the Silurian of Lake Huron in the Manitoulin island, in Michigan and Ontario, assist in confirming the view that the sea in which the Silurian deposits of the Lake Timiskaming basin were deposited was connected with the Silurian sea of the Lake Huron region.

Notes on Mr. Barlow's collections.

Chief island, Lake Timiskaming.—The fossils from this locality are poorly preserved, and occur in a rather coarse sandstone showing clear grains of quartz embedded in a light yellowish-grey dolomite. The beds from which they were obtained appear to form the basement or lowermost strata of the Silurian as developed at this point. The presence of *Halysites catenularia*, Linnæus, and of *Discosorus conoideus*, Hall, with other forms from this island, serve to indicate the presence of Silurian rocks on the southern side. These strata, which rest unconformably upon the denuded Archæan rocks whose surface is very irregular and uneven, must necessarily have contacts at various horizons or levels. It would not be at all surprising, indeed, to find arenaceous beds not only belonging to the Niagara formation and holding fossils representing different life-zones in this formation, but also similar beds holding older types of organisms, belonging to older formations in the lower levels of this old Palæozoic outlier or basin.

Mann island.—The bulk of the large collection obtained during the years 1893 and 1894 came from this locality. Forty-three species are represented. The rock in which they are preserved is a light-yellowish and fine-grained dolomite teeming with the remains of corals and hydroids. Certain bands, more calcareous, hold brachiopoda belonging to the species *Atrypa reticularis*, Linnæus. Several interesting and thin slabs of crinoidal limestone contain crinoid heads as well as stems. These are of special interest and deserve to be further studied. It is the only locality on the lake where tolerably perfect crinoid heads have been obtained, only imperfect fragments of columns or stems had been noticed previously.

Percy island.—From this place Mr. Barlow obtained only a few specimens from which nine species were recognized. Additional collections from this locality would probably reveal other forms of special interest. As already stated the occurrence of *Halysites catenularia* and *Discosorus conoideus* on this island is sufficient evidence upon which to refer the strata from which they came to the Silurian System.

The Fossil Corals.

In 1896 Mr. L. M. Lambe, of this Department, made a special study of the corals obtained, and he has prepared the following lists of species.—

Mann island, Lake Timiskaming, collected by A. E. *Barlow.*
1893-1894

Heliolites (Plasmopora) affinis, Billings.
Lyellia americana, Milne-Edwards and Haime.
Zaphrentis stokesi, Milne-Edwards and Haime.
Cyathophyllum articulatum, Wahlenberg.
Favosites gothlandica, Lamarck.
Alveolites niagarensis, Rominger (not Nicholson).
Limaria (Cœnites) crassa, Rominger.
Halysites catenularia, Linnæus.
Halysites compacta, Rominger.
Syringopora bifurcata, Lonsdale.
Syringopora verticillata, Goldfuss.

North End of Lake Timiskaming, collected by R. Bell, 1887.

Heliolites subtubulata, McCoy.
Zaphrentis stokesi, Milne-Edwards and Haime.
Strombodes pygmæus, Rominger.
Favosites gothlandica, Lamarck.
Cladopora cervicornis, Hall.
Alveolites niagarensis, Rominger (not Nicholson).
Alveolites seriatoporoides, Milne-Edwards and Haime.
Cœnites lunata? Nicholson.
Limaria (Cœnites) crassa, Rominger.
Halysites catenularia Linnæus.
Halysites compacta, Rominger.
Syringapora Dalmanii, Billings.
Syringopora verticillata, Goldfuss.

The subjoined table enumerates the Silurian fossils found at the several localities in the northern part of Lake Timiskaming, the localities and collectors being as follows:

1. Collection from 'Head of Lake Timiskaming' (*sic*) by Sir W. E. Logan, 1845.

2. From 'North End of Lake Timiskaming.' Dr. R. Bell, (*sic*) 1887.
3. Various collections by Mr. A. E. Barlow from Mann island in 1893 and 1894, also part of the 'Stewart Collection' from Mann island, obtained in 1892.

4. Percy island, Lake Timiskaming, A. E. Barlow, 1894.

5. Chief island, Lake Timiskaming, A. E. Barlow, 1894.

TABLE showing the genera and species of Silurian fossils from Lake Timiskaming.

	1 Head of Lake Timiskaming	2 North end of Lake Timiskaming.	3 Mann island.	4 Percy island.	5 Chief island.
PLANTAE					
Buthotrephis gracilis (?), Hall			•		
palmata, Hall			•		
HYDROMEDUSÆ.					
Clathrodictyon vesiculosum, Nicholson and Murie.	•	•	•	•	
CŒLENTERATA.					
Heliolites subtubulata, McCoy		•			
(*Plasmopora*) *affinis*, Billings			•		
sp., cf. H. niagarensis, Hall.			•		
Lyellia americana, Edwards and Haime			•		
Zaphrentis stokesi, Edwards and Haime			•		
sp.					•
Caninia or Streptelasma, sp.					•
Cyathophyllum articulatum, Wahlenberg			•		
sp. indt.			•		
Strombodes pentagonus, Rominger		•			
Favosites gothlandica, Lamarck	•	•	•	•	
Cladopora cervicornis, Hall		•			
Alveolites niagarensis, Rominger			•		
" *seriatoporoides*, Edwards and Haime		•			
Cœnites lunata (?), Nicholson		•			
Limaria (*Cœnites*) *crassa*, Rominger.		•	•		
Halysites catenularia, Linnaeus		•	•	•	
compacta, Rominger		•	•		
Syringopora bifurcata, Lonsdale			•		
verticillata, Goldfuss	•	•	•	•	
dalmani, Billings.	•	•	•		
ECHINODERMATA					
Crinoidal fragments	•	•	•	•	
Taxocrinus, n. sp			•		
Dendrocrinus sp., cf. D. longidactylus, Hall			•		
Thysanocrinus sp., cf. T. liliiformis, Hall			•		
ANNELIDA.					
Arabellites, n. sp.		•			
BRYOZOA.					
Lichenalia concentrica, Hall			•		
Phænopora expansa Hall		•	•		
Trematopora, sp			•		
Callopora sp., cf. C. nummiformis, Hall		•			
Stictopora, sp		•			

TABLE showing the genera and species of Silurian fossils from Lake Timiskaming.—*Continued.*

	1. Head of Lake Timiskaming.	2. North end of Lake Timiskaming.	3. Mann island.	4. Percy island.	5. Chief island.
BRACHIOPODA.					
Orthis (Dalmanella) elegantula, Dalman		•	•		
" *davidsoni*, de Verneuil		•	•		
Leptæna transversalis, Dalman		•			
Leptæna rhomboidalis, Wilckens			•	•	
Strophonella, sp			•		
Strophomena, (?) sp., cf. *Leptæna corrugata*, Conrad		•			
Chonetes (?), or *Strophomena* (?)		•			
Platystrophia lynx, Eichwald			•		
Leptocœlia hemispherica, Sowerby				•	
Atrypa reticularis, Linnæus	•		•	•	
" *nodostriata*, Hall		•			
" *intermedia*, Hall					
Rhynchotrema cuneata, Dalman		•			
Rhynchonella neglecta, Hall		•			
interplicata, Hall		•			
acutiplicata, Hall					
sp					
Trematospira, sp., indt					•
Spirifer, sp., cf. *S. niagarensis*, Hall			•		
sp., indt		•			
Meristella didyma, Dalman		•			
naviformis Hall		•			
sp				•	
Pentamerus oblongus, Sowerby	•				
GASTEROPODA.					
Bucania stigmosa, Hall		•			
Murchisonia subulata, Hall					
sp. No. 1					
" sp. No. 2					
Loxonema, n. sp.					•
sp					
Euomphalus, n. sp					
Euomphalus alatus, Hisinger			•		
Cyclonema cancellatum, Hall		•			
Platyostoma, sp.		•			
LAMELLIBRANCHIATA.					
Modiolopsis, sp., cf. *M. erectus*, Hall		•			
Pterinea, sp.				•	
CEPHALOPODA.					
Discosorus conoideus, Hall	•	•	•		
" *gracilis* (?), Foord			•		
" sp. No. 1		•	•	•	
" sp. No. 2		•	•	•	

TABLE showing the genera and species of Silurian fossils from Lake Timiskaming—*Concluded.*

	1 Head of Lake Timiskaming.	2 North end, Lake Timiskaming.	3 Mann island.	4 Percy island.	5 Chief island.
CEPHALOPODA—*Continued.*					
Orthoceras, sp.			•		
" sp., cf. *O. elevatum*, Hall		•			
" sp., cf. *O. virgulatum*, Hall			•		
" sp., cf. *O. cadmus*, Billings (= *O. subannulatum*, Hall)			•		
Orthoceras rotulatum, Billings	•				
Actinoceras vertebratum, Hall (? *A. Bigsbyi*, Stokes)			•		
TRILOBITA.					
Calymene niagarensis, Hall (= *C. Blumenbachii*, Brongniart)		•			
Illaenus, sp.		•			
Encrinurus, sp., cf. *E. punctatus*, Wahlenberg		•			
Proetus, sp.		•			
OSTRACODA.					
Beyrichia, sp., cf. *B. lata*, Vanuxem		•	•		
Isochilina, sp.		•			
Leperditia, sp.		•			

References.

1857. BILLINGS, E.—'Report of Progress, Geol. Surv. Canada, for the years 1853-6.' Toronto, 1857. On p. 334 *Orthoceras rotulatum* is described from the head of Lake Timiskaming.

1858. BILLINGS, E.—'Report of E. Billings, paleontologist, in Report of Progress, Geol. Surv. Canada, for the year 1857.' On pp. 147 and 171 Mr. Billings describes, and records the discovery of, *Syringopora dalmanii* and *S. verticillata*, Goldfuss.

1858. BILLINGS, E.—'Canadian Fossils, containing descriptions of new Genera and Species from the Silurian and Devonian formations of Canada.' Extracted from Report of the Geol. Surv. Canada for 1857. Montreal, 1858, 31 pp.

1863. BILLINGS, E.—'The Geology of Canada, from the commencement until 1863,' pp. 334-336 contains a chapter entitled: 'The Niagara Formation on Lake Timiskaming,' in which two lists of fossils prepared by Billings are given, p. 335.

1888. FOORD, ARTHUR H.—'Catalogue of the Fossil Cephalopoda of the British Museum,' Part I., Nautiloidea, London, England, December, 1888:—in which *Actinoceras vertebrale* is recorded from Lake Timiskaming.

1896. WHITEAVES, J. F.—'Canadian Stromatoporoids,' Can. Rec. Science, vol. V., No. 2, pp. 129-146, December, 1897, in which *Clathrodictyon vesiculosum*, Nicholson and Murie, is recorded from Lake Timiskaming.

1897. AMI, H. M.—'Notes on some of the Fossil Organic Remains from the Geological Formations and Outliers of the Ottawa Palæozoic basin.' Trans. Roy. Soc. Can., Sec. Series, vol. II., Sect. IV., 1896-1897, (Ottawa, 1897).

1899. LAMBE, L. M.—'Canadian Palæozoic Corals,' Ottawa Naturalist, vol. XII., No. 11, pp. 219-220, February, 1899, where specimens identified with *Cyathophyllum articulatum*, Wahlenberg, are described from Mr. Barlow's collections on Lake Timiskaming.

THE MATTAWA OUTLIER.

In the autumn of 1894 Mr. A. E. Barlow submitted for examination a small but important collection of fossils from a locality on the north shore of the Ottawa river, six miles below Mattawa. The fauna represented in the pinkish-grey weathering and arenaceous limestones of this outcrop is that of the Black River and Trenton. The presence of *Receptaculites occidentalis*, Salter, *Orthis tricenaria*, Conrad, indicate an horizon at the close or summit of the Black River formation, whilst the occurrence of *Prasopora selwyni*, Nicholson, *Solenopora compacta*, Billings, *Rafinesquina alternata*, Emmons, and *Zygospira recurvirostra*, Hall, are eminently characteristic of the Trenton.

The occurrence of this fauna at such a westerly point along the Ottawa valley and in such proximity to the Lake Nipissing outliers on the Manitou islands, together with the well-known occurrence of strata of the same age in the islands north of the Grand Manitoulin, serve to show that in Ordovician times the marine waters of the Lake Huron Palaeozoic basin were directly connected with those of the Nipissing and Mattawa or Upper Ottawa regions. Every species recorded from this Mattawa outlier has been found in other deposits in the Ottawa valley, whilst most of them, if not all, are also recorded from the islands north of Lake Huron.

The following is a list of the species recognized in the collection from this outlier:

PROTOZOA.

Receptaculites occidentalis, Salter.

ECHINODERMATA.

Crinoidal fragments, too imperfectly preserved for identification.

They resemble portions of stems of a species which may be referable to the genus *Glyptocrinus*.

BRYOZOA.

Prasopora selwyni, Nicholson. The microscopic sections prepared of this form exhibit no variation from typical specimens recorded from Peterborough, Ottawa, Montreal and other localities in Canada. This is no doubt the form which received the designations of *Favosites lycopodites*, *Chaetetes lycoperdon*, and *Stenopora petropolitana* in the early reports of the New York and Canadian Surveys.

Frondose, and branching Monticuliporidæ.

Solenopora compacta, Billings. A form which may probably be referred to this species.

CŒLENTERATA.

Streptelasma corniculum, Hall.

BRACHIOPODA.

Strophomena incurvata, Shepard.
Rafinesquina alternata, Emmons.
Orthis, sp., cf. *O. tricenaria*, Conrad.
(Dinorthis) proavita, Winchell and Schubert.
Zygospira recurvirostra, Hall.

GASTEROPODA.

Lophospira bicincta, Hall. A young individual referable to this species.

TRILOBITA.

A fragment of a trilobite too imperfectly preserved for identification.

LAKE NIPISSING—THE MANITOU ISLANDS.

In 1854 Alexander Murray was the first to note the occurrence of flat-lying limestones on the Manitou islands of Lake Nipissing. In his Report for that year (p. 124) he refers the occurrence to the Black River formation. '*Ormoceras tenuifilum*,' or as this species is now called, *Actinoceras bigsbyi*, Stokes, is the characteristic form upon which the determination of the horizon was based.

In 1884 a further collection was made on these islands by Dr. A. R. C. Selwyn. This was subjected to a preliminary examination by the writer.

In 1896 a brief note was prepared for the Canadian Record of Science where seventeen species are enumerated.

In 1889 Mr. T. D. Ledyard, of Toronto, visited these islands and obtained an interesting collection, which was submitted to Mr. E. O. Ulrich for examination. The list of species prepared by the latter and embodied in a paper on the Black River limestone at Lake Nipissing by Prof. N. H. Winchell, in the American Geologist for September, 1896, contains besides other forms a number of Bryozoa not previously recognized from this locality.

In 1892 Rev. J. M. Goodwillie, M.A., of North Bay, made an excellent collection of the fossils, and communicated them to the Geological Survey Department at Ottawa. This collection was found to contain a number of forms hitherto unrecorded in other collections, and a preliminary study of its contents revealed many interesting species, all eminently characteristic of the Black River formation.

In 1894 Mr. A. E. Barlow collected along the west shore of the Great Manitou or Newman island, on the most southerly of the Manitou islands and on the west shore of McDonald island. From the first-mentioned of these collections by Mr. Barlow a Black River fauna was detected and *Columnaria halli*, Nicholson, *Stromatocerium rugosum*, Hall, *Lophospira helicteres*, Salter, and *Actinoceras bigsgyi*, Stokes, recorded, all of which are eminently characteristic. The presence of *Zygospira recurvirostra*, Hall, and of a form which is doubtfully referred to *Plectambonites sericea*, Sowerby, from the west shore of McDonald island, give a slight Trenton facies to the assemblage from this locality. It may be that further collecting will reveal a somewhat higher horizon than the zone of *Columnaria halli* usually indicates.

The following collections of fossils have been examined by the writer:

Manitou islands, L. Nipissing, A. R. C. Selwyn, 1884.

Manitou islands, L. Nipissing, Rev. J. M. Goodwillie, M.A., 1892.

West Shore, Great Manitou islands, L. Nipissing, A. E. Barlow, 1894.

West Shore, McDonald island, L. Nipissing. A. E. Barlow, 1894.

Most southerly of Manitou islands, L. Nipissing, A. E. Barlow, 1894.

The subjoined list of genera and species includes all the forms recognized in these as well as in the other collections above mentioned.

PROTOZOA.

Stromatocerium rugosum, Hall.
Pasceolus globosus, Billings.

CŒLENTERATA.

Columnaria halli, Nicholson.
Tetradium fibratum, Safford.
Palæophyllum? sp.
Streptelasma corniculum, Hall.

ECHINODERMATA.

Crinoidal fragments, too imperfectly preserved for identification.
Sculptured plate of what appears to be a cystidean referable to the genus *Palæocysites*.

BRYOZOA.

Escharopora subrecta, Ulrich.
Escharopora limitaris, Ulrich.
Helopora mucronata, Ulrich.
Rhinidictya mutabilis, var. major, Ulrich.
Phyllodictya varia, Ulrich.
Batostoma winchelli, Ulrich.
Callopora multitabulata, Ulrich.
Several other Monticuliporoids referable to genera and species not yet examined microscopically, but which appear to belong to such genera as *Pachydictya*, *Amplexopora*, *Dekayia*, *Coscinium*, and *Monotrypella*.

BRACHIOPODA.

Strophomena incurvata, Shepard.
" *trentonensis*, Winchell and Schuchert.
Rafinesquina alternata, (Emmons).
Plectambonites sericea, Sowerby.
Orthis tricenaria, Conrad.
Rhynchotrema inæquivalvis, Castelneau.
Zygospira recurvirostra, Hall.

GASTEROPODA.

Ecculiomphalus trentonensis? Conrad.
Pleurotomaria (Clathrospira) subconica, Hall.
Murchisonia (Lophospira) helicteres, Salter.
" " *bicincta*, Hall.

GASTEROPODA—*Concluded.*

Maclurea? sp. indt.
Fusispira elongata, Emmons.
Trochonema umbilicatum, Hall.

LAMELLIBRANCHIATA.

Cyrtodonta huronensis, Billings.
" *canadensis,* Billings.
" *subcarinata,* Billings.
Cyrtodonta sp. indt.
Ctenodonta levata, Hall.
Vanuxemia? sp. Hall.

CEPHALOPODA.

Vaginoceras multitubulatum, Hall.
Gonioceras anceps, Hall.
Actinoceras bigsbyi, Stokes.
Cameroceras proteiforme, Hall.
Nanno aulema, Clarke.
Orthoceras rapax, Billings or a very closely related species.
" *multicameratum,* Hall.
" *annellum,* Hall.
" *amplicameratum,* Hall.

TRILOBITA.

Asaphus, sp. Portion of the hypostome of a large individual of this genus possibly of *A. platycephalus* or *A. susae.*

OSTRACODA.

Leperditia fabulites, Conrad.
Aparchites neglectus, Ulrich.

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1892. AMI, H. M.—'Palæontological Notes. No. 11. On the occurrence of Fossil Remains on the Manitou islands, Lake Nipissing, Ontario.' Can. Rec. Science, vol. V., No. 2, pp. 107-108, Montreal, 1892. Contains a review of Alex. Murray's paper (*loc. cit. supra.*) together with a list of fossils obtained by Dr. Selwyn in 1884, and referred to the Black River formation.

1896. Ulrich, E. O.—In Prof. U. H. Winchell's paper entitled: 'The Black River Limestone at Lake Nipissing.' American Geologist, vol. XVIII., No. 3, pp. 178-179, Minneapolis, Sept., 1896. A list of the species of fossils collected by T. D. Ledyard, Esq., of Toronto, in 1889, and determined by Prof. E. O. Ulrich, is embodied in this paper.

1898. Whiteaves, J. F.—'On some Fossil Cephalopoda in the Museum of the Geological Survey of Canada, with descriptions of eight species that appear to be new. Ottawa Naturalist, vol. XII., No. 6, pp. 116-127, Ottawa 1898. On p. 116 Mr. Whiteaves records the occurrence of *Nanno aulema*, Clarke, from the collection made by Alexander Murray in 1854, from the Black River limestone at Western Manitou island (now called McDonald island), Lake Nipissing.

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